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The Metals

In copper, spelter and lead, the metals, other than iron, of most interest to producers in this country, there have lately been interesting and spectacular movements. While we have from time to time referred to these, it is worth while once again to summarize the situation.

The advance in copper has continued until the goal of 15c., which had long been looked at so fondly but seemed to be at an unattainable distance, has not only been reached but also has been passed. Boomers are now talking of a still higher price and are deprecatingly hinting of "a runaway market, which, of course, would be unfortunate as previous experience has shown." We do not believe that there need be any fear of a real runaway market.

The spectacular advance in copper has indeed some amazing features. It is undeniable that there has been an improved, nay even a crazy, demand from manufacturers in this country, but granting that, such a pyrotechnic advance as we have had in the face of the serious industrial disturbances abroad, and the increased production in this country, fails to inspire confidence, especially when the statistics be examined.

Such as examination shows that the average of domestic deliveries in 1911 was about 59,000,000 lb. per month; of foreign, about 63,000,000 lb.; a total of 122,000,000 lb. There is no reason to suspect a noteworthy recent increase in European consumption, which during 1911 was already at high-water mark, and we have learned from previous experience that when our monthly shipments to Europe jump to 80,000,000 lb., as they did in December and January, the meaning is over-buying from there, irrespective of whether it be subsequently reflected in the reports of visible supply or not. Assuming that actual consumption in the United States is now going on at the rate of 10 per cent. increase over the average of 1911, and that the European consumption has been maintained, there is an actual requirement from our refineries of about 128,000,000 pounds per month, but that figure was about the amount of their monthly production in 1910, before the curtailment was inaugurated, and since then several important new mines have begun producing, e.g. Miami, Chino, Ray, Bonanza, Mason Valley and Braden, which are now turning out about 12,000,000 lb. per month, while Utah has made a noteworthy increase.

During 1911, when the prospects for copper seemed gloomiest, we pointed out repeatedly that the new production would come gradually, not suddenly, and would not come so early as anticipated, wherefore increasing consumption would have a fair chance to eat into the accumulated surplus. The events have borne out that forecast, but now we have the condition where the new production that has been coming gradually is actually looming large. In January, 1911, the production of the smelters was about 139,000,000 lb., and their February production was probably nearly as large, allowing for the shorter month. In November, December and January the refiners reported a total of 354,000,000 lb.; the smelters a total of 377,000,000 lb. The flood of increased production from the smelters has not yet fully reached the refiners, but some of it has, and the conclusion cannot well be escaped that crude copper is being, to some extent, piled up at the refineries.

When the first advance in copper culminated at about 14.30c. early in January, one leading seller, continuing to offer this metal liberally, sold the market down to 13.75c. Some of the other large agencies at that time withdrew from the market, and the needs of consumers continuing large, they were soon starved into paying the price demanded by those

sellers who had remained out of the market, and then the price advanced further. The *bona fide* character of this advance is not to be denied, but it is incredible that there has been such an increase in consumption as to absorb the current production, and more, and there is certainly ground for suspicion that operations in the metal market have been connected with speculation in the stock market. If there has been a reserved supply of crude copper, it must of necessity come out sooner or later. Until the statistics of the Copper Producers Association show a monthly production of upward of 130,000,000 lb., we do not think that they will be of any broad significance except as to deliveries.

An explanation of the crazy buying of copper by domestic manufacturers is that having become frightened they are now doing what for more than four years they have refused to do, namely, covering their requirements for a long way ahead and assuming the carriage of part of the accumulation which the producers have heretofore had to shoulder alone, but if this be the case, the psychology that has delayed such action until the new supply of copper is actually with us is indeed amazing. At the moment, the market is very sensitive to the demands for relatively small quantities.

Up to the end of January the price for lead was 4.45c. New York, which is regarded as about a normal figure, perhaps a little low. Suddenly the American Smelting & Refining Co. cut its price to 4c. and took possession of the market, independent sellers being unwilling to let go of their product at that price. Here we had a reversal of the usual practice, which is a maintenance of price by the big seller and cutting by outsiders. Dismissing the trivial explanations of the action by the A. S. & R. Co., we may assume that it cut the price in order to dispose of a surplus stock. It was very particular about not allowing any of its product to fall into speculative hands, evidently desiring to see it transferred to the yards of manufacturers, whence it would not return into the market. About the middle of March, having apparently accomplished its purpose, the A. S & R. Co. advanced its price to 4.20c. Outside producers, not having been selling lead in the meanwhile, stock in their hands probably increased to some extent as they decreased with the A. S. & R. Co., but such action was limited inasmuch as a large part of the lead of all producers goes into consumption upon contracts based upon the average monthly quotation, wherefore, the independent producers had the reservation only of their uncontracted supply.

The present position in lead seems to be that inasmuch as it is cheaper than what is considered to be the normal average price, just as copper and spelter are dearer than their respective normal averages, speculative interests are anxious to buy and carry lead. This attitude, of course, is with reference to the probable general movement, not with reference to temporary fluctuations week to week, or even month to month. There are no important new supplies of lead in sight, changes in the tariff are probably still far distant, and with the gradual improvement in general trade, which is now reasonably to be anticipated, the real consumption of lead ought sooner or later to restore the price for it to the natural level.

We have on several occasions discussed the remarkable situation lately existing in the market for spelter. During the last fortnight there has been a recession in the price for this metal, which has been due, we think, in part to the fictitious basis upon which the domestic market was previously resting, and in part to the weaker tone in Europe. Whether it be because of increased production abroad, or decreased consumption, owing to labor difficulties, or to both causes, the position of spelter in Europe has of late been distinctly less strong than it was a little while ago. In this country the market has continued to be intrinsically very strong, naturally producing a high level of price, but some speculative interests not content with this were greedy for more, and by reckless bids for deliveries known to be unavailable established fancy prices that were, however, realized on but small quantities. The point was reached naturally when other interests became able by international operations to release spelter previously smelted in bond and sold for export and upon offering liberal quantities to the boomers at the prices they were bidding established that there was no market for tonnages at such figures, and the bubble was, therefore pricked. This led to a nominal recession in price, and the market has lately had the appearance of being weak, but in fact it is still much stronger than it looks, the intrinsic position continuing sound. Yet it is not to be denied that spelter at anything over 5.5c. fetches a fine price and the natural consequence is the stimulation of new production that sooner or later extinguishes extraordinary profit.

Is there a Smelters' Trust?

A representative in Congress secured recently the passage of a resolution inquiring of the attorney-general what he had done toward prosecuting the so called smelters' trust. The attorney-general promptly replied that his department had been unable to discover any such trust and had found free competition to exist in the smelting business. The inquiry from the House of Representatives was, of course, directed toward the American Smelting & Refining Co. The attorney-general said in effect that it was not a monopoly, being simply a big company, and had not violated the Sherman law so far as he could find out. This was in substance what had previously been reported by a Federal grand jury having the A. S. & R. Co. under investigation.

Of course, every sensible person acquainted with the mining industry has been aware that competition exists in the smelting business and to an extent in fact that has seriously cut into profits in certain districts, e.g. Utah, where the A. S. & R. Co., the U. S. company and the International company have plants. In Colorado the Ohio & Colorado company is a competitive buyer, in the Southwest there is the Copper Queen and in the East there is the Pennsylvania Smelting Co. Each of these concerns is too strong to be driven out of the field, and recognizing that nobody would attempt it. Besides these smelting companies there are in certain districts concerns employing hydrometallurgical processes, such as chlorination and cyanidation, that compete for some kinds of ore. Modern conditions of transportation have given the ore market a national width. Lead ore is carried from Idaho to Pennsylvania, silver ore from Cobalt to Denver, copper matte from California to New York. Nor is the producer of ore limited to the metallurgical companies. There are no bars against the acquisition of knowledge and skill in the art, nor in spite of the spook of a money trust is there any prohibition

against raising funds for metallurgical plants. Thus we find constantly that concerns like the Goldfield Consolidated and the Nipissing Mines adapt or invent processes and treat for themselves ores that formerly they shipped to smelters. The smelters, thus deprived of profitable supplies, have to cut rates on other ores in order to draw in the quantity needed to keep their plants in economical operation.

So long as we have a science and art of metallurgy and a profession of metallurgical engineers and so long as we have the free scope of individualism that has made industry in the United States a gigantic thing, there will be competition in ore treatment. If it appears that the American Smelting & Refining Co., or any other company, handles the larger part of certain classes of ore the reason is that competition, possibly indirect competition, has so reduced the margin on such ores that investors know that any further attempt to capture them in general would merely spell ruin. Rival concerns like the Ohio & Colorado, United States and International that see some possibly profitable branches have been quick to seize upon them, the big mining companies that develop adequate supplies of ore that can be beneficiated more cheaply than by consignment to the smelters promptly build their own works, the visionaries who erect works at Tintic, Ogden, Sandpoint, etc., on the hypothesis that the big smelters plunder the miners acquire some costly knowledge of the economics of metallurgy and the bones of their furnaces are soon added to the other derelicts of the desert.

Conservative Mine Accounting

The last report of the National Lead Co. contains a brief reference to a mining investment that is instructive, inasmuch as it deals with an operation in which no public participation was invited, of which no shares have ever been on the market, and as to which there is no question about deferred charges, etc. It has been merely a straightforward business undertaking.

In 1897 the St. Louis Smelting & Refining Co., a subsidiary of the National Lead Co., acquired property in the disseminated lead district of southeastern Missouri. It was fortunate in acquiring good property, and in connection with it built a concentrating mill, which at its time was the last word in mill construction in that district. The total investment was nearly $1,500,000. The property became productive in 1899. At the end of 1905 it had returned one-half of the investment. It is now indicated that at no distant date the parent company will begin to receive a revenue from this investment, from which we understand that the original outlay has now been returned, after the lapse of 12 years.

Here is an enterprise in which there has been no need for sophistry in distinguishing between expenditures on operating and on capital account. The investing company put its money into the venture and figured that it had to get back its principal before it could reckon that it was making anything. If all mine accounts were kept in this way there would be more stability to mining as an industry, but not much chance for adventurous promoters in the stock-market.

The Steel Corporation Report

The affairs of a corporation which has gross receipts amounting to over $630,000,000 in a single year naturally require an elaborate report, and this the Steel Corporation has furnished for the year 1911. The statements in this report are very full and generally clear, though in some parts a careful analysis is needed to get at the essential figures. The main difficulty to be found is that in some cases there is a certain amount of complication between the affairs of the Corporation itself and its subsidiary companies; and the reader wonders if a more compact organization might not be feasible and advantageous. Moreover, the financial statements occupy so much space that there is no room to go into actual costs of manufacture.

The Corporation is primarily a maker and seller of finished steel, though its operations cover the whole range of operations leading up to that point. It is a miner of iron ore and coal, a maker of coke and pig iron, as well as a steel maker and finisher, and a seller of cement and some other byproducts. Outside of its steel operations it sells a considerable quantity of iron ore and coke. Although its make of pig iron was not quite sufficient to supply its steel furnaces and it bought some bessemer and basic iron on the open market, it sold 310,000 tons of pig; but this was mainly foundry iron from Alabama.

The year covered by the report was one of some depression in trade, and the total production of finished steel was 11.7% below that of 1910. In November, under the stimulus of lower prices, business became very active, but the revival came too late to make up for the earlier depression. The deliveries of finished steel to domestic buyers showed a decrease of 18.6%, though this was partly made up by a gain of 41.4% in the export business, the foreign trade being the heaviest ever reported.

The gross earnings, as above given, were reduced by working expenses and repairs, general expenses and taxes to a net of $104,305,466, from which payments for interest and sinking funds, and for "extraordinary replacements" left a balance of $55,300,297 available for dividends, this balance being about 8.75% of the gross receipts. The report does not make it quite clear how the discrimination between ordinary and extraordinary repairs are made. One statement gives "ordinary maintenance and repairs" at $37,882,851, and "extraordinary replacements" at $7,077,414. On the other hand, the income account charges to "depreciation and extraordinary replacement funds" $18,229,060.

The surplus was sufficient to pay the usual dividends of 7% on preferred and 5% on common stock, and to leave an undivided surplus of $4,665,495; but it was not sufficient to permit any appropriation for the additions to property which are really necessary to keep the Corporation in line with its competitors. Such expenditures were made in 1911 to the amount of $54,603,081, the money being supplied largely from the sale of bonds of the subsidiary companies.

The report gives full particulars of the Corporation's fuel resources, its ownership of coal lands and mines, but is much less specific as to its iron-ore reserves. A brief history of the Great Northern ore leases and their prospective cancelation is included in its general statement. There is also brief reference to the government suit for the dissolution of the corporation.

Upon the whole, the report is as satisfactory as might have been expected. At any rate, it shows that in a year of comparative depreciation and low prices all obligations could be met and the rate of dividends maintained.

A New Iron Ore Deposit in Pennsylvania?

Several of the daily papers last week heralded an alleged discovery of iron ore in Ayr township, Fulton County, Penn., the estimates of its quantity ranging from 500 to 1000 million tons, much of which was said to be of bessemer grade. According to these reports, the discovery was made by J. N. Crossland, of New Florence, Penn. In looking for an extension of the Broad Top coal seam, he came across a strange geological formation in what is known as Meadow Mountain. Soon afterward he discovered float ore and "after careful investigation reached the conclusion that there were valuable deposits of iron ore in the mountain and vicinity." The newspaper reports proceeded further to say that "More than 50 assays have been made from samples taken from as many different places by eminent chemists, including the chemist of the University of Pittsburgh, showing an average percentage of metallic iron, ranging from 57 to 63 per cent."

These reports naturally excited widespread interest, but in spite of diligent inquiry we have been unable to discover any iron-mining engineers, or ironmasters, who had previously been aware of this occurrence. We communicated with Mr. Crossland, and in reply to our dispatch received from Hayden, Evans & Hayden, of Greensburg, Penn., owners of the deposits, a letter under date of Mar. 25, comprising the following statements:

> The ore discovery reported in the newspapers is a fact and all accounts we have read have been substantially correct. The property contains vast deposits of mineral wealth and our claim is for one billion tons, at least, of high-grade iron ore, consisting of black hematite, brown hematite, red hematite and carbonate of iron. The ore lies in three mountains, viz., Meadow Ground Mountain, Lowrie's Mountain and Dickie Mountain, which form a spur of the Blue Ridge range. The acreage is from twelve to fifteen thousand. The property has been undergoing exploration by Mr. Crossland, our engineer, since October, 1911. Colonel H. C. Demming, state geologist of Pennsylvania, has examined that part of the property known as Lowrie Mountain. Mr. F. B. Peck, professor of geology and mineralogy in Lafayette College, Easton, Penn., leaves tomorrow to make an investigation of the ground. The method of exploration thus far has been by core drills and blast mines. We have had more than 50 analyses made of specimens taken from widely removed sections of the property which show from 57 to 63% iron, with only traces of sulphur and phosphorus.

Col. Henry C. Demming informs the JOURNAL as follows:

> I made a brief investigation of the iron-ore deposits in Ayr township, Fulton County, Penn., two years ago. While there is an abundance of iron ore there, principally brown hematite, in my opinion the estimated deposit of commercial ore is far short of one billion tons, and the quality much less than stated in some daily papers. Selected samples may contain 60% metallic iron, but it is doubtful whether any of the orebodies will average 50%. It is barely possible that the geological fault in that vicinity is due to a mighty upheaval, with iron beneath, but that ought to be confirmed by careful investigation with core drills and over a wide area of territory. In 1881 Dr. J. J. Stevenson, geologist, University of New York, made a careful survey there.

Dr. George Otis Smith, director of the U. S. Geological Survey, is quoted by the daily papers as saying:

> It is, of course, quite possible that such a discovery has been made, but the weight of probability lies against it. The State of Pennsylvania has been thoroughly explored and all available bodies of ore are believed to be known. Indeed, the work has been regarded as so well done and so nearly completed that the U. S. Geological Survey has done no work there for years in iron. We continue to work on the coal deposits, but in the matter of iron, that is a work left entirely to the State geologists.

Dr. David White, of the staff of the U. S. Geological Survey, is reported as saying:

> I can imagine that in Pennsylvania there may be regions so little known that such a deposit might exist there. It is true that farmers do not always recognize the value of deposits they may encounter, and the geologist may not have happened to pass that way. The region is in the line of similar deposits. We have known of some occurrences of iron ore in Pennsylvania where it was so thin and so silicious that it was not available commercially, and it may be that some such deposit has been found. Ultimately, when the orebodies of the Southern Appalachian and the Lake Superior regions have been exhausted, we shall return to the thin and silicious ores that have been passed by in Pennsylvania and make use of them.

Prof. J. F. Kemp is quoted as follows:

> I do not believe that such an immense body of ore as has been reported can have escaped the notice of the many prominent geologists who have carefully gone over the ground. Many geological maps of this region by the best authorities are in existence, but they show no indication that such a deposit exists. The geological formation of the country itself tends to disprove the story that such a large deposit of ore can be present in that locality.
>
> I am also inclined to doubt that any very large quantity of ore exists with so high a percentage of extractable metal as the reports indicate. It is possible that a few sporadic cases show so high a test, but I cannot see how more than 1,000,000,000 tons of the so called ore can be found to have tested out at 60% iron.
>
> Before making too decisive a statement on the discovery I wish to wait until a thorough investigation of the claim is made by the best authorities. Personally I have never been over the exact ground where the ore is said to be deposited, but I am more or less familiar with geologic formations in Pennsylvania as a whole and I cannot see how this immense deposit has escaped notice for so long.

The newspaper reports about this discovery have been of a character to arouse skepticism. An enormous tonnage of ore cannot be safely estimated on the basis of superficial exposures and a small number of samples.

A distinguished mining engineer and geologist of Pennsylvania characterizes the reported occurrence as being improbable and practically impossible, calling attention to the fact that the iron-ore deposits of the Trenton limestones are limonites, of the Clinton red fossil ore, and of the Oriskany brown hematites, all of which are well known deposits and generally small, of relatively low grade and rather high in phosphorus.

It is evident that these deposits must await more extensive engineering and geologic examination before the claims for them may safely be accepted.

Investigation of Alleged Smelting Trust

WASHINGTON CORRESPONDENCE

Representative Martin, of Colorado, has introduced his resolution calling for the investigation of the smelting trust by a committee of Congress. Mr. Martin has had this action in mind ever since the reply of Attorney General Wickersham to the inquiry of the House concerning the trust, in which the latter denied that any such organization exists and asserted that the companies are in actual and live competition.

In speaking of his resolution, Mr. Martin says:

> The reply of the Attorney General to my original resolution was astounding. He boldly tells the House that a smelter trust does not exist and declines to say what steps, if any, are being taken to ascertain the existence of such a trust which I have charged as being one of the most audacious of all illegal combines. I am now asking for a Congressional investigation of the trust, and in the event this resolution is adopted it will necessarily throw some light upon the financial and political relations of the Guggenheims. Not only will the Guggenheim "barrel" run like slag from a furnace in lining up Taft delegates in Colorado, but in the event of his nomination the same barrel will be used to debauch the electorate of the state.

Mr. Martin makes the direct charge that the Attorney General is shirking his duty in not prosecuting so powerful an "ally of the administration" as the smelter trust. He absolutely denies the assertion of the Attorney General that there is no smelter trust, and that competitive conditions prevail in the industry. If this were true, he says, it would be better worth investigating than other trusts in order to ascertain how these conditions have been kept up.

Correspondence and Discussion

Views, Suggestions and Experiences of Readers

Use of Vanadium Bearing Sands

In the JOURNAL of Feb. 17, 1912, A. D. Banfeild asks whether the Patea sands, containing 0.15 to 18% vanadium (and also some iron) may be used as a source of vanadium, with particular reference to the manufacture of vanadium steels. I have been professionally interested in the chemistry and metallurgy of vanadium for several years and will be glad to furnish any information I possess.

From the nature of his question it seems reasonable to suppose that he wishes especially to know whether the ore can be directly smelted into ferro-vanadium. There are several reasons why this is not commercially possible at present. Aside from the question of economical work there are several chemical and metallurgical factors to be considered. In the first place, the present practice demands that the carbon content of the alloy be low, and as vanadium will form carbides when carbon is present in small quantities, vanadium carbides will be formed from the carbon introduced to reduce the iron. Again, vanadium acts strongly as either acid or base, and it is entirely probable that the slag would contain most, if not all of the vanadium in the charge.

J. ROSS CORBIN.

Denver, Colo., Mar. 13, 1912.

Sulphur in Sulphide Ores

Under Stuart S. McNair's article in the JOURNAL of Mar. 16, 1912, is an editorial note which says in part, "the method fails when barium is present in the ore, unless some sodium carbonate is used in the fusion." Without investigating that point, it may be pointed out that many of the accepted methods for pyrites at present are intentionally mapped out so that sulphur combined with barium is not found or reported, as such sulphur is not available for acid making.

I may add that there should be a better understanding on this point in drawing pyrites contracts, as the buyers' and sellers' chemists are constantly disagreeing on sulphur when barium is present, and investigation usually shows that one has obtained total sulphur, and the other sulphur excluding that carried as barium sulphate.

While the sulphur in calcium sulphate is, I believe, largely wasted, so far as the acid maker is concerned, this sulphur is usually reported with sulphide sulphur.

Although somewhat out of a fertilizer chemist's line, is it not also true that in blast-furnace work if pyrites is used as a sulphur carrier barium sulphate is wasted sulphur. I believe that the classic statement is, "barium sulphate is reduced to sulphide, which as such enters slag and matte, making the one heavy, the other light." This is, however, quoted from memory, and is subject to correction. A. F. W.

Baltimore, Md., Mar. 22, 1912.

Where Should the Primer Go?

Referring to the article on high explosives, written by A. E. Anderson, which appeared in the JOURNAL of Feb. 3, 1912, and to the letter dated, Candor, N. C., Feb. 6, 1912, by Percy E. Barbour, which appeared in the JOURNAL of Feb. 17, 1912, on the question—"Where Should the Primer Go?": The paragraph on position of primer, referred to by A. E. Anderson, deals particularly with gelatin dynamites when used in holes in stopes or drifting work in ore mines where the gelatin is detonated by means of fuse and blasting cap. In these places it is often advisable to place the primer in the bottom of the hole with the business end of the blasting cap pointing toward the main charge of explosive. The main reason for this is, that in lighting the fuse, the first fuse lighted will, as a rule, burn to the cap and detonate that charge of the explosive before any other charges are detonated.

It sometimes happens that when the primers are all placed last in the bore hole, that the charge of explosive detonating first will break the rock in such a manner as to throw out into the muck some of the primer cartridges. These primer cartridges would then detonate in the muck pile. In order to overcome this, some of the miners in the ore mines of Colorado use the method of placing the primer cartridge in the bottom of the bore hole. Wherever this method is followed one should use a fuse which has little, if any, side spit, and thus eliminate the liability of igniting the explosive. Gelatin dynamites, however, are not easily ignited.

If electric fuses were used for detonating the charges and these detonated by means of blasting machines or power circuits, the primer cartridge should be placed in the bore hole last, or next to last. As a rule, with the exception as noted above, the primer cartridge should be placed in the bore hole last, or next to last, whether fuse and blasting cap are used or the charge is detonated by electric fuses.

Several years ago tests were made by the du Pont company to determine whether it would be better to place the primer cartridge in the bottom of the bore hole, in the center of the charge or in the top of the bore hole. From results obtained, no difference in execution of the explosive was noted, except that the business end of the detonator should always point toward the main charge of explosive. From an economical standpoint and also to eliminate the liability of igniting the explosive in the bore hole, it is best to place the primer in the bore hole last, or next to last.

F. H. GUNSOLUS.

Manager, Technical Division, E. I. du Pont de Nemours Powder Co.

Wilmington, Del., Mar. 20, 1912.

The Davis-Biram Anemometer

We have received a cutting on the Davis-Biram anemometer, from the JOURNAL of Feb. 17, 1912, and notice a clerical error in the description of the instrument. The large dial is given as being 13 in. in diam. This should be 3 inches.

Since the particulars of this apparatus were given to Mr. Seager, a shutter arrangement has been fitted to this anemometer which reduces the port holes, and in testing for velocities, say above 30 ft. per sec., the shutter is slid over the port holes. The results then have to be multiplied by 2. For lower velocities, the shutter, of course, is slid back and the port holes are fully opened. It is thus possible with the Davis-Biram anemometer to obtain readings of low velocities and also high with the same instrument.

JOHN DAVIS & SON (DERBY), LTD.

Derby, England, Mar. 12, 1912.

Screening Ore Samples

Doctor Dewey's comment on screening ore samples, in the JOURNAL of Mar. 16, 1912, reminds me of a way of hastening screening operations, I once saw in a small laboratory in the Southwest. The sampler bucked away on the ore until five or six assay tons out of about a 12- to 18-a.t. sample had gone through the screen, then threw the remainder away! The "graphite method" of ore analysis is all that beats this, I think.

HENRY WOODMAN.

Philadelphia, Penn., Mar. 21, 1912.

Calumet & Arizona and Superior & Pittsburg

The reports of the Calumet & Arizona and the Superior & Pittsburg Copper companies for the year ended Dec. 31, 1911, show a total production of 49,945,905 lb. of refined copper, 453,947 oz. of silver, and 18,114 oz. of gold. The precious metals were valued at $24.15 per ton of refined copper, and the net cost per pound of refined copper after deducting the value of the precious metals was 7.34 cents.

As the companies are at present constituted, the Superior & Pittsburg has 2,000,000 shares of stock authorized, of which 1,499,792 are issued, and of which 1,387,946 shares are held by the Calument & Arizona company. The Calumet & Arizona has 650,000 shares authorized, of which 31,956 are held for exchange for the outstanding Superior & Pittsburg stock, while 21,488 are treasury stock.

The Calumet & Arizona company alone produced 21,476,739 lb. of copper; 216,987 oz, of silver; and 9329 oz. of gold. The copper sold for 12.4922c. per lb., and the net cost, after deducting precious-metal contents, was 8.33c. There were 1038 men employed, 562 at the mine, and 476 at the smeltery.

New Smeltery to Be Built

In order to meet changing ores in the properties controlled by the company a new smeltery is planned; grading has been done and active construction commenced. The plans contemplate a complete sample mill; 58,000-ton bedding system; two 48-in. by 40-ft. furnaces with 60x180-ft. dust chamber; a steel stack, 350 ft. high and 25 ft. in diam., lined with acid-proof tiling; four 19x100-ft. reverberatories, with foundation and building for fifth; twelve 21-ft. Herreshoff roasters with dust chambers; and six Great Falls converters 12 ft. in diam. The plant should be in operation by Aug. 1, 1913. In August, 1911, two additional converter stands were put in operation, and during the year the practice was taken up of lining the shells with basic lining. The results at first were indifferent, but are now satisfactory. The process is being worked under agreement with the Peirce-Smith Converter Co. In those shells still run on acid lining, mill tailings have been substituted successfully for siliceous ore.

Development work by the Calumet & Arizona company amounted to 26,196 ft. during the year: 18,754 ft. of drifting; 6039 of raises; 25 of stations; and 1378 of drilling. In the Irish Mag shaft everything above the 750-ft. level has been abandoned, and work confined between the 850- and 1150-ft. levels. On the 950-ft. level a new body of oxide and sulphide ore has been discovered, but except for this, all the work has been on old bodies or extensions of bodies stoped to the Copper Queen side lines by the Copper Queen company. Surface work through the Irish Mag shaft has also been discontinued, hoisting being carried on through the Oliver shaft.

In the Oliver shaft oxide ore has been found in the 1050-ft. level of the Senator claim, and the 1250-ft. level of the Buckeye, while new sulphide ore has been found in the 1250-ft. level of the Senator claim, and the 160-ft. level of the Oliver. Diamond drilling was done from the 1350- and 1450-ft. levels of the Gibraltar, which proved that mineralization extends several hundred feet below the present workings, but found no ore.

No work was done on the Courtland exploration, and only assessment work on the Copper Giant. In April, the option on the Superior mine was given up.

Option Taken in Ajo District

In the latter part of the year option was taken on 22 claims in the Ajo district, 42 miles south of Gila, on the Southern Pacific road. The property is that of the New Cornelia Copper Co., and drilling is now being carried on, in hope of finding a large body of disseminated ore. There were 265,831 wet tons of ore mined in 1911 (244,067 dry tons), and 266,607 tons shipped. Of first-class ore there were 231,135 tons smelted, and of fluxing ore, 42,474 tons. The copper recovery per wet ton of ordinary ore was 89.747 lb., and of fluxing ore, 12.25 lb. On the dry basis the recovery from the two classes was 4.884 and 0.670%, and the contents 5.154 and 1.059% respectively.

In the Superior & Pittsburg mines development work amounted to 25,222 ft. during the year: 63 ft. sinking; 18,092 ft. drifting; 6416 ft. raising; 97 ft. stations; 554 ft. drilling. A connection was made with the 1000-ft. level of the Cole shaft and 1350-ft. of the Oliver shaft of the C. & A., after which stoping was steadily carried on in the oxide orebody of the Granville claim, which is developed for about 350 ft. on the 900-ft. level.

In the Briggs shaft developments have been most encouraging. The main drift to the southeast has cut sulphide ore, pyrite, or leached mineralized ground for nearly the whole length of 860 ft. In one place 60 ft. of ore assaying from 5 to 6% of copper was cut. One narrow seam has been developed for over 200 ft. in length, with continuous ore of good grade. In addition to these richer bodies, there are great areas of nearly solid iron pyrite assaying from 2 to 4% copper. A good sulphide orebody has also been found northeast of the Briggs shaft. The ore has been developed over 100 ft. long by 35 ft. wide, with an average grade of 8%. The Briggs orebodies are scattered over a thoroughly mineralized zone 2400 ft. from north to south, and 1000 ft. from east to west. It is proved that the rich orebodies of the Bisbee district persist to the most southern point yet reached by development.

The Junction shaft was sunk to 1837.5 ft., cutting sulphide ore at intervals from 1700 ft. to the bottom, and in a small station cut on the 1800-ft. level. This proves that the orebodies extend at least 300 ft. below the present lowest (1500-ft.) working level. Two drill holes were put down to prove the south orebody below the 1500-ft. level, but owing to the complexity of the ground, results were negative.

In the Hoatson shaft work has been largely confined to systematically cutting up the ground adjoining the large oxide orebody, considerably increasing its known size, and resulting in finding several small outlying bodies of oxide ore. Most of the stoping during the year has been in the large orebody.

During the year, the only Superior & Pittsburg mine from which pumping was done was the Junction, 1,579,255,906 gal., of which 35,280,000 were from the Copper Queen mines. After March, 1912, when the connection between the Oliver and Hoatson shafts is completed, the Junction will do the deep-level pumping for all the Bisbee mines.

There were 229,903 wet tons of ore mined (205,603 tons dry), 229,985 wet tons shipped, and 230,620 wet tons of Superior & Pittsburg ore smelted. The recovery of copper was 123.719 lb. per wet ton. The production amounted to 28,469,166 lb. of copper, 236,960 oz. of silver, and 8785 oz. of gold. The value of the precious metals amounted to $21.20 per ton of refined copper, and the net cost, after allowing for gold and silver, was 6.60c. per lb. of fine copper. The selling price was 12.4922c. There were 344 men employed.

The joint income of the two companies was $6,842,683 from sale of metals, and $48,590 from miscellaneous credits. Expenses at mines and smeltery were $3,514,933; construction, $39,008; salaries, office, and general expenses, $81,135; freight, refining, and marketing, $683,954; leaving net earnings on production of $2,572,242. From this, expenses on outside properties and payments on options not exercised of $53,446, less miscellaneous credits of $6525, were met, leaving earnings of $2,525,321 net.

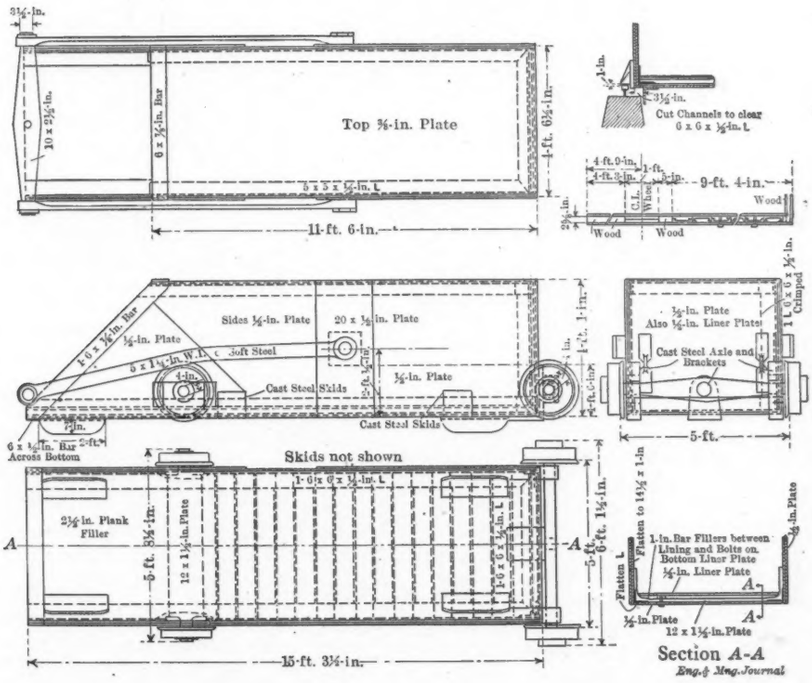
By Senate bill 3045, which was passed by the Senate, sent to the House and then referred to the House Committee on Public Lands, provision is made for agricultural entries on oil and gas lands of the United States, exclusive of Alaska, under existing homestead and desert-land laws. The rights to oil and gas on these lands are to be reserved by the United States.

Details of Practical Mining

Accounts of Useful Ways of Doing Many Things in the Day's Work

The Franklin 10 Ton Skip

A new hoisting engine has been erected at the No. 1 amygdaloid shaft of the Franklin mine, near Houghton, Mich., which is to raise a skip from a maximum depth of 5000 ft. An air cylinder is connected tandem with each of the two steam cylinders of the engine. In hoisting, these air cylinders are not used. In lowering, no steam is admitted to the steam cylinders, but the weight of the descending skip turns the engine backward and a braking resistance is obtained by the compression of air in the air cylinders. This air is discharged into large receivers where it mixes with steam from the boilers and is fed back to the hoist to assist in raising the skip. There is but one hoisting compartment in the shaft, so in order to raise the desired tonnage, a skip of 223 cu.ft. or 10½ tons capacity is required. This skip is by far the largest in the Lake Superior copper country.



THE 10-TON SKIP FOR THE FRANKLIN MINE

The front wheels of the skip, as shown in the accompanying illustration are carried by bracket axles which are bolted to the body of the skip, the clearance between the inside face of a wheel and the body being about one inch. A reinforcing plate through which these bracket-axle bolts pass stiffens the body of the skip at that point. The body is also reinforced at the draft lugs.

Because of the small clearance of the front wheels it is necessary to bend the bridle strap so that it will clear the wheels.

At that part of the bottom of the skip on which the ore from the loading pocket will fall when the skip is being filled a wooden lining is used which extends a little below the reinforcing plate for the bracket axles. The rest of the bottom is reinforced by steel channels, every other one of which is inverted; all are riveted together as shown in the section A-A in the illustration.

The skip is equipped with skids that will take the weight in case a wheel breaks, and also with guide shoes that run over a concrete stringer in the shaft and which guide the skip in the event of its jumping from the rails. The rear through axle is pivoted and is carried in sleeves which allow a play of 1½ inches.

The front and back wheels are alike and are made of manganese steel, while the increase in the tread necessary on the rear wheels for dumping the skip is obtained by a separate hub that is carried outside the main wheels and on the same axle.

This hub is a cheap steel casting as it does not have to take much wear, and is entirely independent of the main wheels. At the rear are lugs for attaching below the skip a truck for lowering timbers. The skip weighs about 6½ tons. The skip track is 5 ft. gage and is made of 80-lb. rails carried on concrete stringers of the Mohawk type.

Maintaining Grade in Driving

In driving and tunnel work the miners unconsciously tend to work on an upgrade toward the face at a steeper angle than is desirable for drainage or for favoring the tramming of loaded cars. Too much grade is disadvantageous because the grade favoring loads is so great that the cars tend to run faster than considerations of safety should permit; greater effort is required to move empty cars up the grade; natural ventilation is interfered with, the results being especially noticeable at the face; and, in some cases, the unnecessary loss of ore in the backs above the drift may be undesirable.

The grade of drifts in some of the older mines of Cornwall is as great as 5%, often 7%. At the present time a drift is rarely driven at a greater grade than 1%, which is twice the grade recommended by some authorities.

To avoid driving at too great a grade, a template should be provided which the miners can use as often as they desire and without losing much time. Such a template may be made by cutting a board of convenient width and thickness so that it is exactly 100 in. long. The edges should be planed true and parallel. A line is then drawn from the upper corner of one end to a point 1 in. below the upper corner of the opposite end and the board sawed along this line. The board is then turned over, and a level-tube let into the edge, which is so adjusted that the bubble will be in the center of the tube when the edge of the board is in a horizontal plane.

In use, the template is laid upon the floor of the drift with the narrower end toward the face. Then if the grade of the floor is 1%, the bubble will be in the center of the tube.

Safety Catch for Cage

By H. L. Botsford*

Many devices have been designed to prevent accidents to mine cages from the breaking of the hoisting rope. They may all be divided into two general classes: safety stops, and safety brakes. The former aim to stop the cage instantly, by some positive means, such as the slipping of bolts into holes in the guide timbers. This class of safety catch would be satisfactory if the cage could always be stopped just at the instant the rope broke, on an ascending cage, and before the cage had acquired any appreciable downward velocity. Should the catches refuse to work until the cage had gained considerable momentum, or should the rope break while the cage was descending, and the speed of the cage should not be entirely checked before the hoisting rope failed, the stresses produced in the safety catches would be too severe for them to resist successfully. Even should the catches be able to stand the strain, there yet would be great danger of bodily harm to the occupants of the cage.

These serious objections to the safety stops, are not so inherent in the second class of safety catches. Safety brakes are designed with the aim to gradually arrest the momentum of a descending cage, without danger to the occupants of the cage, or to the safety-catch mechanism. In one type of safety brake wedges are made to grip the guide timbers, when there is no tension in the hoisting rope. The motion of the descending cage forces them tighter and tighter against the guides until the cage is stopped. This type has not proved satisfactory. In a second type of safety brake, friction shoes are forced against the guides by the action of compressed carbonic acid gas against plungers. The gas is stored in cylinders under a pressure of several hundred pounds per square inch. This type has given good service at the mines of the Rand. It may be used with steel guides. In a third type of safety catch, or brake, much used in America, cams or "dogs" are made to engage the guides, one on each side of each guide. These cams have toothed or grooved surfaces, which cut into the guide timbers. They are quicker in their action than the friction blocks described above, although they may properly be classed with safety brakes because their action is to stop the cage by the resistance which they meet in deforming or cutting the guides. Obviously they can only be used with wooden guides.

This type of safety catch depends for its action upon springs which force the cams against the guides when the tension in the hoisting rope is released. While the weight of the cage is supported by the hoisting rope the cams are drawn back from the guides, and in no way interfere with the free running of the cage.

Much variation is shown in the design of cams, and in the choice of springs. The springs may be of the laminated, spiral, or the helical type. The laminated spring is but little used. In many mining districts one type of cage construction is used almost exclusively.

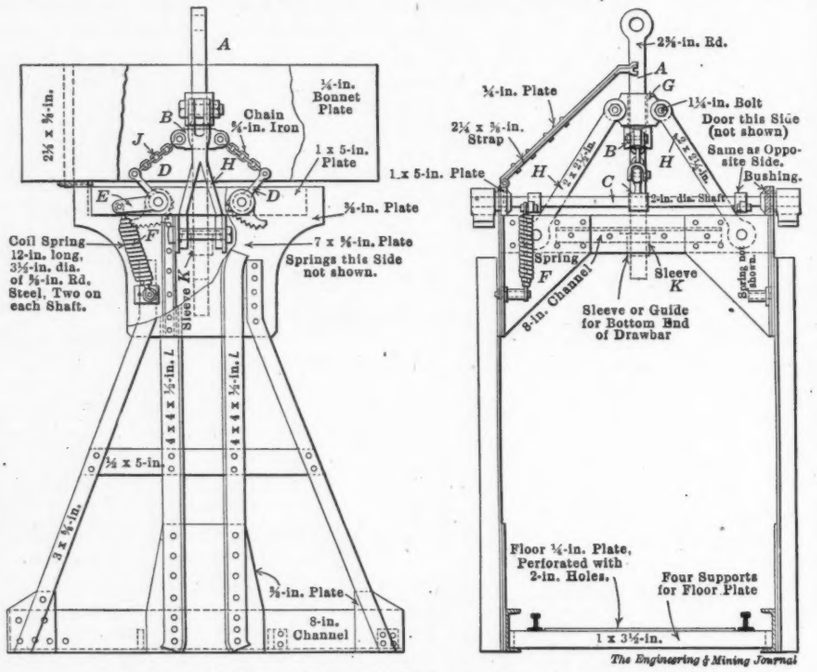
In the accompanying illustration a cage long in use in the copper country of Lake Superior is shown. In this construction the cage is hung by two hanger forks *H* from the draw-bar sleeve *G*, through which the draw-bar *A* is free to slide. While the cage is hanging on the hoisting rope the yoke *B* on the draw-bar carries the weight of the cage.

The springs *F* have one end fastened to the side plates of the cage and the other end to the lever *E*, keyed to the cam-shaft. The cam-shafts are connected to the yoke *B* by the lever arms *D* and the chains *J*. If the chains *J* are of the proper length, the cams will be turned back from the guides, when the draw-bar is raised to its full height, that is when the yoke *B* is in contact with the draw-bar sleeve *G*. This is the position the draw-bar assumes while the cage is suspended on the hoisting rope. The springs *F* are now under tension, and should the hoisting rope break, or the cage be rested upon landing chairs, these springs will rotate the cam-shafts sufficiently to bring the cams into contact with the shaft guides. Any downward movement of the cage will now force the cams into the guides, until they meet with sufficient resistance to support the weight of the cage.

The lower end of the draw-bar passes through the sleeve or guide *K* which prevents it from binding in the sleeve.

The design of the cams themselves is a very important detail in cage construction. They should be so shaped that when they once come in contact with the guide timbers, any downward motion of the cage must force them deeper and deeper into the guides. As to the relative merits of cams with notched or grooved faces, and those with projecting teeth, much may be said in favor of each. The sharpened teeth will be more certain to cut into the guides at the start, while the other type makes a stronger construction.

Regardless of the type of cage, the safety catches should be tested regularly at least once each month. This is conveniently done by hoisting the cage a few feet above the collar of the shaft, and suspending it there by a hemp rope fastened to a convenient timber in the headframe. The hoisting rope should now be slackened a few feet and the hemp rope severed. This gives the cage a free drop until the catches work, or the slack in the hoisting rope is taken up. With safety catches in good order they should not permit the cage to drop more than a few inches.



A Lake Superior Type of Mine Cage

Compared with steam pumping, bailing possesses some distinct advantages where it does not interfere with hoisting of ore; initial cost of machinery is less, a heavy loss in steam condensation is obviated, repairs and upkeep are lower and there is no danger of the unwatering plant being flooded.

*Mining engineer, Creighton Mine, Ont.

Vertical Stadia Wires

By Douglas W. Jessup*

The use of vertical instead of horizontal stadia wires is a novel way of obtaining measurements. I have never seen this method described in books on surveying, nor until lately in practice. The rod or tape is held in a horizontal position, not vertically as in the common practice of stadia measurements, and at right angles to the line of sight of the instrument. The reading, multiplied by the cosine of the vertical angle plus the constant of the instrument, will give the approximate distance.

In order to use this method, it is essential that the two vertical stadia wires be placed in the diaphragm of the telescope parallel with the vertical center wire, and equally distant on each side of it, preferably so adjusted that this distance divided into the focal length of the object glass is equal to one.

The rodman in giving the sight will find it convenient to use a tape, holding it across his chest and at the height of the instrument, folding two pieces of white paper over the tape, one at the zero mark, and adjusting the other along the tape. When the distance becomes too great for the rodman to stretch his tape, one end is fastened to some convenient point, or the end of a stick and extended out as far as necessary.

This use of the vertical stadia wires is not so accurate or satisfactory as using the horizontal wires, but it affords good results under certain conditions. The disadvantage lies in that it is difficult to hold a tape at right angles to the line of sight. The advantages are in its affording better opportunities in giving a sight, not clearing the brush and etc., and it may be used at odd times with a tape when a rod cannot be obtained, the rodman finding it much more convenient to stretch out a tape in a horizontal position than in a vertical one. At times it is also more rapid. This method was satisfactorily used in a railroad survey, involving switchbacks up a mountain side.

*Mining engineer, Bingham, Utah.

Stoping at the Calamon Mine*

By C. P. Corbett Sullivan†

The following is a brief description of the modifications that have recently been introduced in the method of stoping adopted by the Calamon silver-lead-zinc mine at Posadas, Spain.

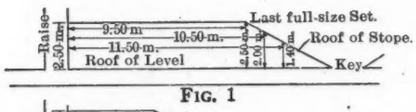


Fig. 1

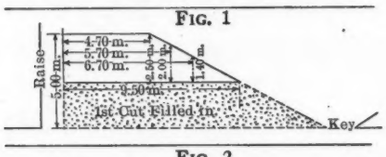


Fig. 2

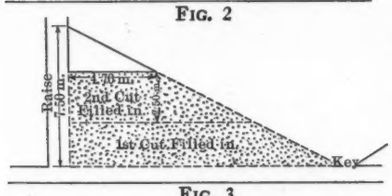


Fig. 3

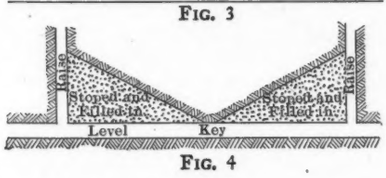


Fig. 4

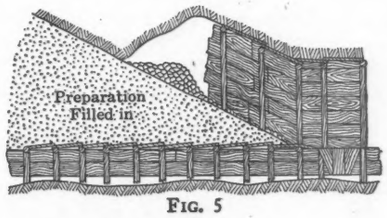


Fig. 5

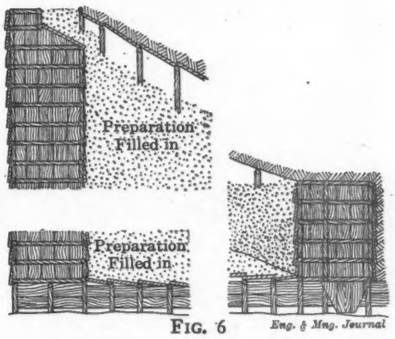


Fig. 6

Cut and Fill Stopes at Calamon Mine

The operation of preparation is always easy, as it is limited to the construction of inclines. To make these, the first cut is started and carried out until a length of 9½ m. is reached. At a distance of 10½ m. a set 2 m. in height is put in, at 11½ m. another 1.4 m. high is put in and the cut brought to a finish with a total length of 14 m. along the floor. The roof of the stope forms, with that of the level, the apex of a right-angle triangle, in which the former is the hypothenuse, the latter the perpendicular, and the last full-size set, the base, as shown in Fig. 1 of the accompanying illustration. When this has been filled in the usual way, the second cut is started 5 m. above the back of the level and is driven horizontally until 4.7 m. in. When 5.7 m. long, a set 2 m. in height is put in, and at 6.7 m. another, 1.4 m. high is put in, and the drift carried on with the roof at the same inclination to join the cap-piece of the last full-size set at 9½ m. from the raise in the first cut, as shown in Fig. 2. This must, as usual, be filled in before the third and last cut can be stoped away, which is commenced with a total height of 7½ m. and the roof brought down with a uniform drop to meet the roof of the second cut where it starts to descend, as shown in Fig. 3. The same routine is gone through in the other half only in an opposite direction; the 30 m. run from raise to raise, resulting in two incline planes of 53.57% rise and 14 m. horizontal base, which diverge from the respective extremities of a key left in the center, 1.4 m. long, as shown in Fig. 4. This concludes the preparation. The same operation is necessary in the other slopes.

The inclinations of the planes were naturally derived from the angle of repose of the broken material, which was found to be 33°; the angle was selected less than this so that the material would not feed into the bins of its own accord, for if it did it would subject the timber to needless wear and tear. It was, moreover, anticipated that some broken material in the end would be beneficial by saving the time and cost necessary to build up temporary staging essential for drilling purposes. Had the angle of repose been approached too closely the filling would probably have run down as well as the ore.

In stoping the key is first taken out perpendicularly until 2½ m. high, then an intermediate level of the same height is driven up the incline to hole with one of the raises. The broken material is, as the end is advanced, raked down the incline to the bin with *legones,* in accordance with the trammers' requirements. A *legone* is a toothless hoe, and is generally used for filling the baskets constructed of *esparto* grass, hemispherical in shape, and provided with two handles. These *espuertas* or baskets are laid on the instep and the ore raked into them. They are useful in the incline and give much better results than would be obtained with shovels.

In Fig. 5 is shown the first cut being taken out; the others are taken out in a similar way. It will be noticed that the central bin is not built in a similar way to the raises. This is not done until one side has been holed and the next is a few meters in, which prevents them getting shattered by close blasting. As soon as one has holed, the next one is started in the opposite direction.

*Excerpt from an article entitled "Stoping at the Calamon Mine," Bull. 88, I. M. M.

†Mining engineer, Wilkie Hotel, St. Stephen's Road, Bayswater, London, England.

The rest is carried on in exactly the same way, with the exception of the last three cuts on each side, which hole into the floor of the level in a similar way to the raises. This is generally done by laying down sollars 6 m. long, one on each side of the floor of the level and parallel to it, with two corresponding cap-pieces along the roof inside the other set and at right angles to them, which are kept in position with uprights and cross pieces. This allows the stope to hole safely with the level. These timbers when finished are removed and used elsewhere. In filling ends it is only necessary to board up the excavated side of the central bin, construct a chute in the part of the raise into which the stope was holed, supply it with waste from the level above and let the water run in. This is almost invariably sufficient, though it is customary for the miner working in the other section of the stope to go occasionally and ascertain that the material is running down well, and if not, to set it in motion. Fig. 6 shows a cut being filled in. The hydraulic method of filling is used. It is stated that the saving affected by this method of stoping over and above the cost of the method previously used was about 58,000 pesetas, a figure equivalent to two months' profit.

Engine Foundations

Engine foundations perform two functions; they hold the engine bed rigidly in place and they absorb vibrations. The foundation must, therefore, be heavy and bulky and it must have a substantial and firm bearing in the earth. Concrete is by far the most available and best suited material for this purpose. It is not only a comparatively inexpensive material but it is also exceedingly convenient to handle and to mold into the necessary form. Moreover, states R. B. Dale in *Power*, with intelligent supervision, the foundation may be built without the use of skilled labor. However, sufficient time must be allowed for the concrete to set before a load is placed on the foundation.

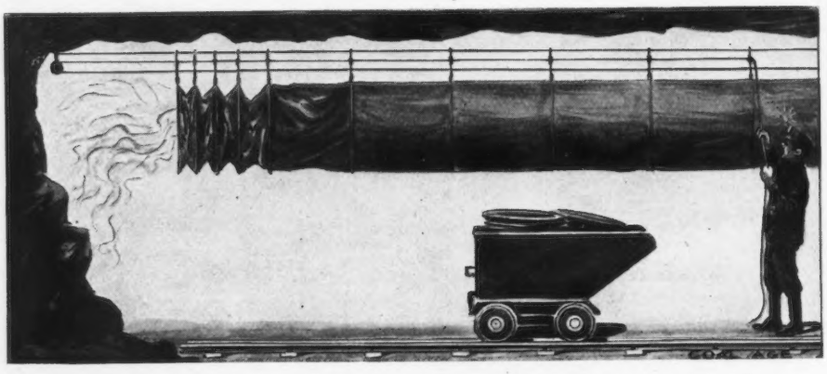
The engine base is held to the foundation by means of anchor bolts. These are mild-steel rods several feet long with a square nut and anchor plate at one end and a hexagonal nut at the other. The foundation is usually built and the anchor bolts set in the places indicated for them on the engine builder's setting plans before the engine has been shipped so that the foundation may be ready to receive it when it arrives. The anchor bolts are hung from a template which is securely fastened to the top of the forms for the concrete, and the anchor plate is completely buried in the concrete. A small wooden box, tapering from the lower end to the upper end, is made to surround the anchor bolt; this allows for a slight adjustment of the bolt so that it will fit into the cored holes provided for it in the engine bed. This precaution is necessary because it is almost impossible and, in any case, too expensive, to set them so that an accurate fit is obtained.

When the engine arrives and after the concrete has properly set, the engine is moved to its foundation where it is set in position. Small iron wedges are driven under the edge of the engine bed until the engine is level, thus leaving a space of ½ in. or more between the engine base and the top of the concrete. The hexagonal nuts on the upper ends of the bolts are then tightened, after which cement grout is run under the engine base and allowed to set. When the grout has set the wedges are removed and the nuts on the anchor bolts are again tightened as much as possible.

In order that the foundation may perform to the fullest extent its function as an absorber of vibrations, the vertical hole through which the anchor bolt passes is not filled with grout. This allows the bolt to stretch or elongate throughout its entire length whenever subjected to shock. It may be said to act somewhat in the manner of a spring. If the anchor plate is of ample area, no advantage in holding-down force is obtained by grouting the bolt for its whole length as the bond between the steel and the concrete is comparatively slight. Any lateral movement of the engine on the foundation is prevented by the friction between the engine bed and the top of the foundation. The greater the initial tension in the bolts, the greater is this resisting force. If a slight movement should take place this resisting force would increase enormously because the tension in the bolts would increase as they are stretched to accommodate themselves to the new position. Shearing strains which are liable to occur in the bolt between the top of the foundation and the engine bed, if it is completely bedded in the grout, are also prevented.

Collapsible Air Ducts for Mine Fires

The usual way of supplying air to the men fighting a mine fire is by the use of props, boards and brattice cloth, but where the cross-section of the heading is too narrow to permit of the erection of such a side airway, air conduits can be used. These may be made of cloth, and can be folded up like Chinese lanterns as is shown in the accompanying illustration. They are easily carried from place to place. These cloth conduits, which are described by Gustav Ryba in *Zeitschrift des Zentral-Verbandes der Bergbau Betriebsleiter Oesterreichs,* are made and sold in Vienna. In order to prevent the collapse of the cloth cylinders with consequent obstruction of the air, they are stiffened by steel rings within. According to the data furnished by J. Jicinsky, a mine manager, 100 yd. of horizontal air conduit can be laid in 15 min. The ventilation may be obtained from a small portable fan, driven by hand or other power.



AUSTRIAN DEVICE FOR APPROACHING FIRES

The use of such conduits is by no means restricted to fighting mine fires. They can be used for ventilating raises, the work of driving which is perhaps the most trying that a miner has to endure in the usual every-day work at a mine, because of the heat and bad air. In driving long drifts, especially when tortuous, some means of ventilation is desirable both from the standpoint of comfort of the miners and from that of costs. In such crooked drifts the powder gases are very slowly diffused and if some means of accelerating ventilation is not provided much time may be lost by miners waiting for the smoke to clear before returning to the face.

A similar device was in use about two years ago at one of the Goldfield Consolidated mines in Nevada when a long tortuous drift was being driven. The air was supplied by a fan at the shaft station and was led to the working face through a light galvanized-iron pipe. The use of canvas pipe as a means of ventilation has been previously noted in this department of the JOURNAL.

Details of Metallurgical Practice

Records of Experience in Ore Dressing, Cyaniding and Smelting

Acid Treating Filter Leaves

By C. H. Fox*

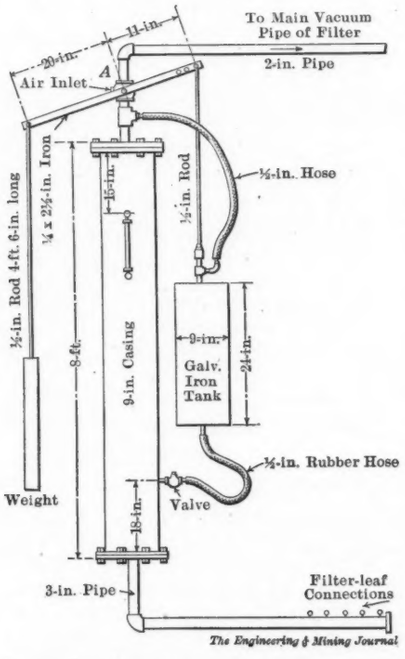
The accompanying sketch shows a device for assisting the acid wash of filter leaves. It is in use at the West End mill, at Tonopah, Nev. The leaves are placed into the acid tank and connected to a 3-in. pipe by means of the usual filter couplings. This pipe leads to the bottom of a drum 8 ft. high, made from 9-in. casing. A 2-in. pipe connects the top of the drum with the main vacuum pipe of the filter.

A stop and drain valve, placed in the pipe above the drum, automatically controls the vacuum and air inlet. This valve is fitted with a lever. A weight is suspended from one end and a galvanized-iron tank from the other. This tank is fitted with two pieces of ½-in. rubber hose, one at each end. The upper hose leads to the top of the drum and connects with the 2-in. pipe between the stop and drain cocks and the drum. The lower one is fitted with a valve and connects with the drum about 18 in. above the bottom.

After the filter leaves have been placed into the acid bath and connected to the pipe leading to the bottom of the drum, the valve in the pipe between the top of the drum and the filter vacuum pipe is opened. The acid is then drawn through the filter leaf and up into the drum. The level of the acid in the drum is for a time shown in the gage glass. As the acid rises in the drum some flows through the lower hose into the galvanized-iron tank.

After a level has been reached at which the weight of the acid in the tank exceeds the weight on the other end of the lever, the tank drops and closes the valve at the top of the drum. The vacuum is shut off and air admitted through the air inlet *A*. The acid returns to the acid tank by gravity. When nearly all the acid has returned to the acid tank, the weight of the galvanized-iron tank has decreased and the excess weight at the other end causes it to rise.

The vacuum is once more turned on and the cycle repeated. Practice has shown no saving of time is gained, but a much more thorough washing of the leaves is obtained.



AUXILIARY APPARATUS FOR ACID-TREATING FILTER LEAVES

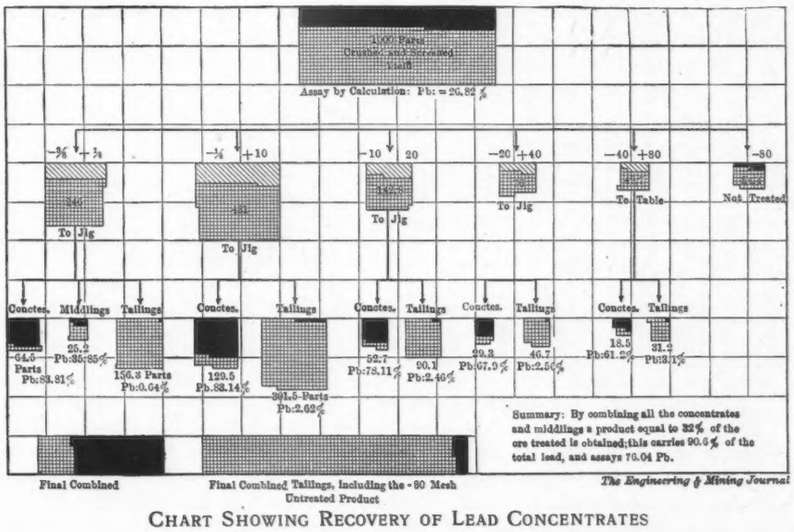


CHART SHOWING RECOVERY OF LEAD CONCENTRATES

*Tonopah-Belmont Development Co., Tonopah, Nev.

Volatile Matter in Coal

The following method seems to do away with the personal equation in determining the volatile matter in coal, writes Frank E. Lathe.

Weigh 1.0 gram of sample into a previously weighed porcelain crucible. Cover, and fasten the cover in place with thin iron wire. Place in the bottom of a 20-gram crucible (as used in fire assaying) and fill the large crucible level full with wood charcoal, well broken up. Cover the crucible with a scorifier, and place in a muffle for half an hour at a temperature of 1000-1100° C. Remove from muffle, allow to cool in charcoal then reweigh crucible: The loss in weight represents the amount of moisture and volatile-combustible matter.

Graphic Method of Illustrating Extraction Tests*

By H. K. Picard†

There is herein suggested a graphic method of reporting the results of extraction or concentration tests on ore samples, which has been found particularly suitable when a large number of products result. The method has been in use in my laboratory for some time past, and is generally approved by those interested. So far as I am aware, nothing similar has been published, though it is quite possible that like devices are employed in other laboratories and works.

As an example I give a concentration test on a lead ore where the number of products is not excessive; even in this simple case it will be admitted that the graphic method is easier to follow than would be a list of figures detailing the results of such a test. For instance, a middling product which assays 30% lead at once gives the

*An article entitled "A Graphic Method of Illustrating the Results of Extraction Tests," Bull. 89, I. M. M.

†Mining engineer, 44 London Wall, London, England.

impression that it is too rich to be ignored and will require re-treatment. But reference to the graphic statement shows that the amount of this product is so small as to render re-treatment inadvisable or unnecessary, and that it may be mixed with the bulk of the concentrates without appreciably lowering their value.

A sheet of squared paper divided into tenths is most suitable for the diagrams required in the graphic method of illustration. Each square is taken to represent a convenient weight of ore, say 1 lb. or 1 gram, according to requirements. A parallelogram is drawn containing a number of squares equal to the weight-units taken for the test. In the example given 1000 lb. of ore were taken, and are shown by 1000 squares at the top of the sheet. The tenor of the ore in lead is represented within this figure by a wash of solid color occupying squares equal to the amount of metal present. In this instance the ore assays 26.8% lead, and therefore 268 squares are colored. The sample was then crushed and graded into the products shown, the size of each figure again being proportional to the weight. The lead tenors of each grade are similarly shown, except that, not being final products, the amounts of metal are represented by cross-shading. The —80 grade was not further treated, and thus became a final product; its lead contents are therefore shown in solid color.

Following the diagram, each grade was separately concentrated, yielding the products indicated—these again being shown relatively to their weights; and, being final products, their lead contents are represented in wash. All the lead originally present is thus divided up and shown in the final products, the sum of whose weights and contents is equal to that in the original ore taken.

In the example, purposely selected for its simplicity, there is obviously no difficulty in deciding what to do with the products; but with complex ore yielding various middlings of differing values, the diagrammatic method will be found of assistance in deciding whether such products should be rejected, re-treated, or mixed with some other product. Two or more metals can be shown by employing different colors. With gold or silver ores the amount of metal would be too small to show proportionately, but the relative amounts may be indicated if some convenient unit be selected. Thus the small squares may be taken to represent 1 grain, 1 dwt. or 1 gram per ton, according to the richness of the ore or concentrate.

The size of the unit to be adopted in any particular case will be determined by the smallest product to be shown. This must be of appreciable dimensions, and should conveniently occupy not less than ten squares. A unit square of 1/10 in. has usually been found suitable. The suggested method is applicable to operations other than concentration, though it is in regard to the latter that it has been found specially useful.

A Chilled Iron Stamp Shoe

The lower edges of ordinary steam-stamp shoes quickly wear away, resulting in the formation of a convex face. This wearing continues until the lower portion of the shoes becomes quite round and therefore inefficient. Instead of crushing the ore, the shoe rams it or pushes it away, resulting in a great decrease in the output of the mill. But when the shoe is so formed that the outer edge of the wearing face is harder than the middle portion, the sharp particles of quartz or other rock will wear

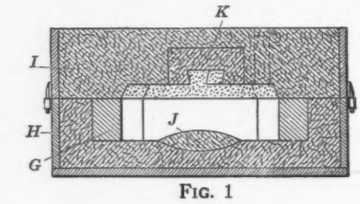


FIG. 1

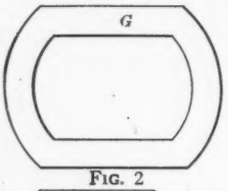


FIG. 2

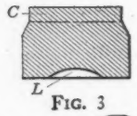


FIG. 3

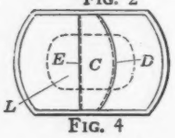


FIG. 4

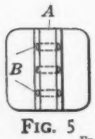


FIG. 5

FIG. 6

Eng.& Mng.Journal

DETAILS OF SHOES AND CASTING FLASK

away the middle of the face as fast as the outer edge. The action of the stamp is more effective when the bottom face of the shoe is slightly concave. Shoes of cast iron, formed by pouring the metal into a mold having a chilling member, have been found most effective, and to have the longest life. They virtually consist of a central core and an outer shell, the shell being much harder than the core. A patent (U. S. pat. 1,012,664) has been granted to Charles L. Lawton of Hancock, Mich., covering shoes of this type and methods of casting them.

In the accompanying drawings, Fig. 1 is a transverse section of a mold for such a shoe; Fig. 2 is a plan of a chill; Fig. 3 is a cross section of a shoe with section lines to indicate the relative hardness of the metal and Figs. 4, 5 and 6 are plans of different forms of shoes of this type.

The shoes may be of any desired form. Figs. 4, 5 and 6 show shoes that are of different cross sections. Any desired means may be employed to secure the shoes to the stamps, ribs *A* provided with boltholes *B* being shown in Figs. 5 and 6, while in Fig. 4 the rib *C* has a curved side *D* and a straight side *E*, inclined toward each other so as to furnish attaching means for the stamp head. The chill *G* may be of any desired thickness, depending upon the depth and degree of hardness desired.

The flask *H* may be of the usual construction, and the sand *I* may be either "green" or "dry."

To insure slow cooling of the middle or core of the shoe a pad *J* of asbestos, properly prepared sand, or other good non-conductor of heat, may be placed in the bottom of the mold. A portion *K* of the mold may be of dry sand to properly form the rib *C*. According to the claims of the inventor the output of ore per stamp when equipped with a shoe having a hard outer edge and softer middle portion, and the life of the shoe, are both much greater than those of a shoe of uniform hardness equal to or even greater than the hardness of the outer edge of the shoe of this invention, owing to the fact that the shoe of uniform hardness becomes rounded while the shoe of his invention remains slightly concave or flat.

This shoe may be used until worn away, while the usual shoe of uniform hardness throughout often becomes practically useless when less than one-fourth of its volume has been lost. The depressions *L* in the bottom faces of the shoes may be of any desired dimensions.

Covering for Cement Floors

Although there may be no danger of permanent physical disorders arising from working on cement floors, some feel more fatigued at the end of a day's work than where a softer floor covering is employed, states H. C. Sundell in *American Machinist*. Still where cement floors are already laid it is not always possible immediately to change to a more desirable surface, even though the men show signs of weariness.

A good way to offset the undesirable features of cement floors is to lay, at such places where men stand at their work, sheets of 3-ply roofing felt which can, in warm weather, be cemented to the floor with the same kind of cement used in making the joints on the roof. This covering lies flat, is easily swept, is pleasant to work on and wears surprisingly well considering the character of the material. At places where men spend a great part of their time the covering will give good service for 10 or 12 months. The price too, is greatly in its favor, as the cost is less than $3 per hundred square feet.

Notes from Current Literature

Concerning Mining, Metallurgy and Industrial Chemistry

Zinc Dust as Precipitant

The problem of the physical constitution of zinc dust was recently taken up by M. T. Murray (*Journ.* Chem. Met. and Min. Soc. of So. Africa, December, 1911). Screening tests showed the following: None of the material remained on a screen with aperture 0.0197 in.; 94.54 per cent. of the whole passed the smallest screen used (aperture 0.0030 in.). The average diameter of the particles was calculated as 0.0011506 in., which corresponds to a surface of 144.8 sq.ft. per lb. of material; this is about three times the surface exposed by 1 lb. of filiform zinc. Under a microscope, zinc oxide and other impurities were seen to be present, but quite separate from the metallic particles which were approximately spherical and retained their bright metallic luster even after several weeks' exposure to the atmosphere. H. A. White stated that a threefold increase of surface was insufficient to account for the greatly increased rate of precipitation by zinc dust compared with that obtained in the usual extractor boxes, so that there must be another factor involved.

Electric Reduction of Aluminum

On the Continent the electrical smelting of aluminum is now exclusively effected in furnaces having conductor melting bottoms and several electrodes, while the melting bath is kept liquid exclusively by the electric current says the *Mining Journal*, Feb. 24, 1912. The cross-section of the furnaces is in all cases rectangular, and they are provided with a series of anodes. There are practically only two types of furnaces used, which are distinguished from one another by the different strength of the electrodes and the construction of their melting bottoms. One type has four rows of electrodes with from six to eight electrodes per row, and the melting bottom is composed of compressed carbon, into which four large iron plates are inserted as conductors. A drawback of this type is that, when the furnace is blown in, strong tar vapors are developed. With the second type of furnaces the melting bottom is only partially used as a conductor, and the total number of electrodes is ten. For each electrode there is a corresponding anode of equal size. In all cases the bottom is slightly inclined toward the gate of the mold. Each electrode must be so arranged that it can be regulated by itself independently of the others.

Each factory jealously preserves the secret of the composition of the melting bath used by it, but in all cases the density of the bath must be inferior to that of the metal, so that the latter can accumulate at the melting bottom. Cryolite melts at 1000°, but it is possible to reduce the melting point to 915° by an addition of Al_2O_3 (up to 5%), or even to 800°, by the addition of fluoride of calcium or aluminum. The density of cryolite is 2.92 in its solid and 2.08 in its liquid condition, against 2.6 and 2.54 respectively for the density of aluminum. It is not advisable to have more than 25% of aluminum (in the form of alumina) in the melting bath. The flux most commonly adopted is fluoride of calcium. The following figures (ascertained by practical experience) regarding the production of aluminum are of interest. Efficiency of the smelting process: Theoretically 42 grams per kilowatt-hour, practically 30 grams per kilowatt-hour; efficiency, 71%; from 50 to 55 kg. aluminum may be reckoned a fair capacity per furnace and per 24 hr. The voltage used is from 8 to 10 volts; density of current from 1.5 to 3 amp. per sq.m. cross-section of electrodes. The consumption of alumina per kilogram of the finished aluminum is theoretically 1.888 kg., and practically 2 kg. Further costs, in addition to those of handling and current, are those necessitated by 100 grams of cryolite and 900 grams of anodes per kilogram of aluminum.

Heating by Blast Furnace Gases

A recent abstract from *Stahl und Eisen* (*Chem. Trades Journ.* Feb. 4, 1912) discusses the utilization of blast-furnace gases for the drying of molds and the heating of drying ovens in the iron foundry. Blast-furnace gas is superior to either solid fuel or producer gas for these purposes, since the latter fuels cause deposits of ash, soot, or tar. A way is suggested of reducing a danger always present when blast-furnace gas is used for drying purposes. The refined gas is at once odorless and poisonous, and a man may easily be overcome by it before its presence is noticed. It is impossible to prevent entirely leakages from pipes and burners, and it has, therefore, been found necessary to mix the gas with something that will give it an easily noticeable smell. Calcium carbide has been adopted for this purpose. The gas, in its passage through the pipes, is caused to pass over a wire basket containing lumps of carbide, which absorb moisture from the gas and give off acetylene. The cost is trifling, especially as the heating value of the gas is somewhat increased. Means must be provided for shaking periodically the basket to free it from accumulations of calcium oxide.

Testing Mine Air

Owing to the difficulty the average assayer is having in making the tests of mine air prescribed by the Transvaal government, Dr. J. Moir republishes his method for CO_2, in the Journal of the Chemical, Metallurgical and Mining Society of South Africa (Jan., 1912).

The stock solutions must be made with recently boiled distilled water, and kept in amber bottles with vaselined stoppers. They are as follows: *Sodium Carbonate* —Ignite chem. pure Na_2CO_3 then weigh out 2.120 grams and make up to 200 c.c., with distilled water. This gives an $\frac{M}{5}$ or $\frac{N}{10}$ solution. *Alcoholic phenolphthalein* —Dissolve 2.120 grams in 200 c.c. absolute alcohol. This gives an $\frac{M}{30}$ solution. From these make up the working solution, which keeps only half a day. *Working solution*—In a clean 200-c.c. bottle place 2 c.c. of the sodium-carbonate solution, and 6 c.c. of the phenolphthalein solution, then 192 c.c. of the boiled distilled water. Use narrow pipettes and do not blow in them.

Sample the air in the required place by blowing into a clean 200-c.c. bottle with a bellows. The nozzle must be narrow enough to enter the sample bottle; if necessary use a rubber tube on the bellows to achieve this end. The operator must keep his face away from the entrance valve of the bellows. Replace the stopper of the bottle.

Take a measuring glass delivering 12.9 c.c. of working solution, fill it and empty into the bottle, and shake continuously for two minutes. If the pink changes to yellow or becomes colorless the air is bad (over 0.2% CO_2). If it only fades slightly, the air is good. If the pink nearly disappears the CO_2 is about 0.2%. Do not expose the main working solution to the mine air more than is necessary.

The solution strength and quantity are calculated to test for 0.2% of CO_2 at a

net elevation of about 3000 ft. above sea level; for a net elevation of 5500 ft. use 11.8 c.c., at 500 ft. net, 14 c.c. For other set standards of purity, alter the quantity of solution in direct proportion. If the color is discharged before one minute of shaking, it is a safe asumption that the CO_2 in the air is over 0.3 per cent.

The Schumacher Briquetting Process

The Schumacher process for briquetting iron flue dust, or flue dust mixed with fine ores, has come into large commercial use in Europe and a small plant is already in operation in the United States by the Cambria Steel Co., at Johnstown, Penn. The process rests upon the observation made by Doctor Schumacher in 1908, that blast-furnace flue dust, possessing of itself no binding or cementing properties, acquires strong cohering properties if mixed with a small amount of certain salt solutions, this amount being so small that the resulting cementing appears to be rather by catalytic action than by mass action of the chemicals added, says Dr. Joseph W. Richards, in a paper presented at the New York meeting of the American Institute of Mining Engineers. For instance, fresh blast-furnace flue dust mixed with 0.25 to 2% of its weight of magnesium or calcium chloride in solution, set in a short time (from 15 to 60 min.) forming a hard cemented briquette.

Alkaline solutions appear to have no such action, and, if present, they interfere with the action of the magnesium and calcium solutions. There is an excess of cementing and setting power, and strongly cementing flue dusts will carry as much as three times their own weight of the fine ore or similar material, and yet produce a satisfactory briquette.

The Cambria Steel Co's., plant consists of two presses, one of which is of the mechanical type, with hydraulic safety regulators, the other is a Ronay hydraulic press. The mixture fed to the presses was: Warm flue dust, cold Mahoning ore and a cold 30% solution of calcium chloride. The mixture as fed to the press was just warm to the touch. The bricks from the press were hot and steaming. The first press consumed 35 hp. with an output of 7 tons per hour, the second press 25 hp. with an output of 4 tons per hour. The flue dust carries from 18 to 20% of coke which is all carried into the mixture, said mixture being 70 of ore to 30 of flue dust. There is from 5.5 to 6% of coke in the finished briquette, the saving of which is sufficient to pay for the entire cost of the briquetting of the dust. The briquettes are decidedly porous, as one absorbed 11.5% of its weight of water, representing 27% of voids. Briquettes one day old, hard dried, gave a compressive strength of 445 lb. per sq.in. Several hundred tons of the briquettes were seen in the ordinary furnace bins ready for use and appeared to have borne transportation to that point and dropping 10 to 20 ft., also the subsequent action of snow and ice for several weeks, without deterioration. Only a few were broken and but little dust was made.

Annealing Temperature for Brass

Experiments have recently been conducted on the proper temperatures for annealing brass in order to attain the best combination of strength and ductility (*Metal Industry*, Feb., 1912). This temperature has been determined to be between 600 and 700° C. It has been shown that the atmosphere of the annealing furnace, whether oxidizing or reducing, does not appear to affect in any well marked manner the properties of the brass.

[However, it is interesting to note that in the annealing of copper, sulphur fumes from coal containing large quantities of sulphur seem to be absorbed by the copper and to render it short.—EDITOR.]

The Bessemer Laboratory of the Royal School of Mines

The equipment of the recently opened Bessemer laboratory, in the Royal School of Mines, London, seems worth noting. According to the *Engineer*, Feb. 2, 1912, it is as follows:

The building is 121x250 ft. Along one side runs a gallery provided with tip trucks running on rails, which will take the ore to the nine 10-ton bins or to the dry-crushing plant which occupies the highest position at the end. Here there are Blake and Dodge crushers, from which a 12-in. picking belt conveys the material to a steel-plate sampling floor or to the stamp house. This house contains one two-stamp 950-lb., one five-stamp 950-lb., and one Huntington mill, with feeders, etc. It is entirely inclosed and has double windows and double walls with an air space between, and is thickly lined inside with felt. All this is done with the object of reducing the noise as far as possible, and in this it is successful. The vibration when the stamps are running is not great. From the crushers the material may be taken to a long series of concentrators and separators of various kinds, and nearly all of full size. There is a Bunker-Hill sizing screen, a two-compartment hydraulic classifier, a 4-ft and a 6-ft. Frue vanner, two No. 5 Wilfley tables, a 20-ft. Acme table, Ulrich and Wetherell magnetic separators, and so on. Besides all this there is a complete cyanide plant; in fact, all the plant that is necessary to demonstrate the usual processes of crushing, sampling, concentrating, magnetic separating, cyaniding, chlorinating, pan amalgamating, and so on, are to be found, with further plant for studying the floatation process of separation, and the drying, roasting and smelting of ores.

Distillation of Alloys in Vacuo

It has recently been determined that when conducting a distillation of copper alloys at about 1200° C. *in vacuo*, zinc, lead and arsenic are quantitatively distilled off, while copper is not seriously affected at this temperature. These results were communicated by Thomas Turner at a meeting of the Institute of Metals in London, Jan. 16 to 17, 1912, and in the opinion of Sir Gerard Muntz give promise for a method by which impure copper may be refined. Iron remains behind with the copper, while a distillation which is quantitative for zinc will carry over only about 10% of the tin present.

Prevention of Cyanide Poisoning

In addition to keeping cyanide antidotes always on hand, the Transvaal Mining Regulation Commission advocates the following preventive measures: (1) Provision of an adequate supply of wholesome drinking water about plants and assay offices, the same to be distinctly labeled "Drinking Water"; (2) the replacement of strong cyanide solution used in the precipitation boxes by water previous to the zinc being handled; (3) the effective hooding of the dissolving bath in which the gold precipitate is treated, and the use of some form of mechanical agitator in order to eliminate the necessity of raising the hood.

Galvanizing Aluminum

In a process for galvanizing aluminum, patented by Mix and Genest, the previously cleansed aluminum is scoured in the ordinary manner and then dipped into a heated acid solution, and simultaneously subjected to the action of reducing agents, such as alcohol, which prevent a too rapid reaction (*Chem. Trade Journ.*, Feb. 17, 1912). After being in this solution for a brief time the aluminum is transferred to an ordinary galvanizing bath. According to experiments, galvanizing thus executed is both durable and can be given a remarkable polish.

Evaporation from Reservoirs

Careful observations and calculations were made by Edwin Duryea, Jr., or worked up by him from Weather Bureau reports, on the evaporation at Lake Tahoe, Calif. (*Eng News*, Feb. 29, 1912). He finds the maximum yearly evaporation would probably be 40.15 in., the minimum 20.52 in. and the average 30.52 in. He deduces that for power and irrigation projects, it would be safe to assume a 36-in. evaporation.

Developments at Stratton's Independence

DENVER CORRESPONDENCE

Stratton's Independence mine, under the management of Philip Argall & Sons, is looking better than at any time for many years, for a discovery was made in hitherto unprospected territory, which opens up unlooked for and great possibilities, not only to the mine, but to the whole district.

Following the phonolite dike south toward the granite on the 200-ft. level of Stratton's Independence, in search of milling ore, a high-grade streak was discovered last October on the east side of the dike. A large amount of ore was stoped out above the level, and a drift was advanced further south and a crosscut driven west, when another vein was found on the western side of the dike. This was stoped to a height of 80 ft., and in this latter stope at 40 ft. above the level the prospecting developed a pipe of rich ore passing into the granite at about 45°. This pipe was followed up to the first level, and in places was 16 ft. wide by about 20 ft. high. It is estimated to have produced about $50,000, with about half this in sight at present, and ore was struck on the first level last week.

Development showed two veins in the granite on the second level, 20 ft. apart, and the big pipe of ore was formed at the intersection of these small veins above, averaging about 30 in. in width. One of the veins has recently been discovered 100 ft. below the third level, and crosscuts are being driven into the granite on the fourth and fifth levels to intersect this new vein system, which obviously is of great importance. Regarding the low-grade ores of the mine, the mill, now that warm weather has arrived and the water lines are thawed out, is running smoothly, treating about 10,000 tons per month, handling dump rock of about $3 grade, as well as about 50 tons per day of mill dirt from the mine, which will average about $5. In fact, the mill has been thoroughly tuned up and is steadily giving definite and profitable results.

This discovery in all probability would never have been made but for the low-grade milling operations carried out by this company. Indeed, this discovery is only one of many that have been made by following up mineralized dikes and veins too low in grade to pay except on the new milling basis, i.e., treating ore at the mine at $1.20 per ton. In developing ore for the new mill, abandoned stopes and prospecting drifts that could not be operated profitably a few years ago, are now giving highly profitable returns in the mill, and an occasional big pocket of rich ore as above described.

Hence it will be seen that when low-grade milling is thoroughly established, the real output of the district will begin, as in following the low grade, even if it only pays expenses, the higher grade and occasional bunches of rich ore will be opened. It is generally conceded by those well posted in the district that the earnings for the last four months are equal to 30% per annum on the capital of the Stratton's Independence company.

Potash in Borax Lake, California

According to official announcements, the two Federal bureaus engaged in the search for potash—the Bureau of Soils of the Department of Agriculture, and the Geological Survey of the Department of the Interior—are in receipt of promising telegraphic news from their field representatives. A bulletin issued jointly by the two bureaus discusses this new potash discovery as follows:

A potash deposit of apparently great importance has been discovered at Borax or Searles Lake in the northwestern corner of San Bernardino County, California. It is situated about 20 miles from the station of Searles on the Owenyo branch of the Southern Pacific R.R. The lake is shown on a map in Water-Supply Paper 224 of the Survey, "Some Desert Watering Places in Southeastern California and Southwestern Nevada."

This lake or playa is the last remaining pocket of a once much greater lake which has almost dried up and its central depression contains a large body of crystalline salts known to consist of common salt and sulphate and carbonate of soda with smaller quantities of borax. This salt body is saturated with brine, and interested persons stimulated by the governmental search for potash recently secured an analysis of old sample material from this brine. The result being significant, the lake was visited jointly by representatives of the Geological Survey and of the Bureau of Soils who took brine samples from six wells distributed over the salt flat. Analyses of these samples have been made by the cooperative laboratory at the Mackay School of Mines, at Reno, Nev., and show an average of 6.78% of potassium oxide (K_2O) in solution. The average salinity of the brine is 43.82 grams of solids per 100 c.c. Comparison of the results indicates that the brines are nearly uniform throughout the flat.

The probable importance of the deposit is due to the occurrence of the potassium salts in soluble form in a natural saturated brine, and under climatic and other conditions especially favorable to its separation and recovery by solar evaporation. Existing data give reasonable assurance that the brine-saturated salt body is at least 60 ft. thick and covers an area of at least 11 square miles. Assuming the salt body to contain 25% by volume of the brine, the total amount of potassium oxide is estimated at over four million tons. This estimate is believed to be conservative, and the available tonnage may well be expected to exceed ten million tons, which would supply the country, at the present rate of consumption of potash, for 30 years. At any rate it appears that this locality constitutes an important source of potash in probably readily available commercial form. Methods of separating potash from brines are now under investigation by the Bureau of Soils.

In connection with this, in a message to Congress on Mar. 26, President Taft urged the immediate enactment of the amendment to the mining laws, introduced recently by Senator Smoot and authorizing the President by withdrawals to save from private exploitation the valuable potash deposits recently discovered in the West. President Taft's message also notes that these potash claims "may be acquired at any time under the placer-mining law by private interests, which will have contributed nothing to their discovery. Similar results will follow future discoveries at government expense."

East Rand Proprietary Affairs

JOHANNESBURG CORRESPONDENCE

The affairs of the East Rand Proprietary Mines still engage attention. The government is prosecuting the late manager, S. Penlerick, for sending in false declarations of gold recovered. Sir George Farrar, at an informal meeting in London, on Jan. 13, defended his actions with regard to the property, putting the blame on his technical advisors. He blamed the unexpected rise in working costs from 15s. 6d. to 19s. per ton for reduced profits. The representative of the Corner House group announced that the reëlection of Sir George Farrar as chairman would not be opposed by them, and apparently the rival interests have been wholly or partially reconciled.

The chairman gave a revised estimate of the ore reserves. In the annual report of 1910, it was stated the ore reserves totaled 10,250,000 tons, valued at 28s. per ton, or, excluding low-grade ore, 7,718,000 tons, valued at 32s. 4d. per ton. The values he furnished, though apparently these had not then been checked by the new management, are: 7,129,838 tons, 32s. 3d.; 1,231,944 tons, 17s. 10d.; 1,686,652 tons, 15s. 9d.; 4,961,756 tons, 8s. 11d. He stated that development during 1911 had shown 9.8 dwt. over 26.4 in. for 34,896 ft., and that a

new overlap portion of reef had been traced over 2400 ft., showing payable orebodies on three levels where driving was being started. He stated that the monthly tonnage treated for the present would be 175,000 tons, and that development was four years ahead of the mill.

At that date shares stood at 75s., having fallen from 100. At present shares have dropped to 52, on persistent rumors that the mines are not in a satisfactory condition as regards ore reserves or prospects in depth, and that further large capital expenditure will be required. Last month showed a profit of £67,000, as against over £100,000 last year and £85,000 recently. No information has been furnished to shareholders as to the results met with by the Cinderella Consolidated in driving through this company's Hercules and Angelo Deep section to connect at the 4000-ft. level.

Since writing the above, the report of the new managing director, Ross Skinner, has been published. He states that the payable ore reserves on Dec. 31, 1911, are really only 6,716,605 tons, worth 28s. over 55 in., and that there exist in the mines 11,150,397 tons, worth 10s. 2d. per ton over 55 in. All ore under 4.3 dwt. has been classed as unpayable, and ore of that grade is included only when occurring in wide stopes. Despite the enormous sums spent in excess development in 1910, the ore reserves were encroached upon for 841,000 tons during 1911, and development work in sinking inclined shafts in the west section must now be pushed ahead.

The most ominous feature of the report is the statement that recent development work, mostly in the lowest level, has shown only a small percentage of payable ore, only 39% of ore developed in the Angelo mine being payable. Large sums must be provided to contend with increase of water in depth, as the neighboring mine to the west, the Witwatersrand Deep, has now to pump 3,000,000 gal. per day. The Hercules 7-compartment shaft must also be sunk from 3000 to 4000 ft., which will involve the expenditure of about £30,000.

The most damaging statements are made with regard to the policy pursued by the late manager. During 1911, it is stated that 205,000 tons of ore, assaying only 1.9 dwt. per ton, were mined and sent to the mill, with 36,426 tons of unpayable ore from surface dumps. Also, during 1910 and 1911, about 78,000 tons of waste packing from old stopes were taken out and crushed to fictitiously lower the costs, and in order to maintain the grade the blocks of high-grade ore were unduly drawn upon. Comment on these revelations is almost needless; sufficient to say that were the truth known, the East Rand Proprietary company is not the only one on the Rand about which similar revelations might have been made in the past, if not at present.

Water in California Oil Fields

SAN FRANCISCO CORRESPONDENCE

The oil-well operators representing the west-side fields of Kern County, which are seriously affected by the infiltration of water, have organized an association that will undertake in a practical way to cure the evil as far as possible. The oil men are now inclined to depend chiefly on their own resources rather than to wait for state aid.

Mr. Storms, the state mineralogist, went to the field and made careful inquiry as to the situation. The present problem is an economic one and his suggestions were in line with the results that followed. Careful estimates were made of the area, the acreage holdings of individuals and companies, and the total production affected; the amount of money necessary to carry on the work under the present law was approximately estimated, and the method of obtaining it discussed. The oil men interested then formed the Kern County Oil Men's Protective Association.

A plan was adopted, as outlined in advance of the meeting, held at Bakersfield, Mar. 9, to raise the money to employ a commissioner to act in accord with the state law of 1909. The law provides for the appointment of a county water commissioner to be paid by the county, but it does not require that the commissioner shall be appointed, nor does it fix the compensation. The appointment was made, but the compensation allowed by the county was inadequate. Under the latest plan the members of the new organization have agreed to levy assessments according to their acreage holdings and production, not to exceed 2½c. per acre per month and not to exceed $^1/_{15}$ of 1c. per bbl. per month. The commissioner selected is the incumbent under appointment of the Kern County board of supervisors. He will perform his labor under the state law and by authority of the county, and extend the scope of his work through the aid of the association. Under the rules it will be his duty to file with the association an exact log of each well; the executive committee of the association will be expected to settle differences between the commissioner and the contributor or producer. It will also be the duty of the commissioner to be present at the time of the shutting off of the water in each well and at the time it is later tested for water, and he must file a report with the committee immediately.

Since the rules adopted by the association affect only the voluntary contributors to the plan there is believed to be no legal objection to their execution. Should an offender refuse to become a party to the plan or to submit to reasonable requirements of the commissioner the latter has the power of the statute to deal with the offender. The amounts of individual assessments for raising funds will not be made public, nor will any private information that it may be necessary to obtain. The entire plan was adopted without dissent. W. N. Forker, the present county water commissioner, was appointed commissioner for the association by the following named executive committee: D. S. Ewing, Timothy Spellacy, S. A. Johnson, H. W. Thomas, T. H. Minor, W. H. Hill, T. M. Young, B. T. Dyer, M. J. Laymance, J. D. Spreckels, Jr., and J. A. Crites.

Bill for Mining Inquiry

A dispatch from Washington under date of Mar. 26 states that the creation of a commission on mining industry to make an exhaustive study of mining conditions in the United States was proposed in a bill introduced in the House by Representative Foster, of Illinois, Chairman of the Committee on Mines and Mining. The commission would consist of 11 members, two Senators, two Representatives, two mine operators, two representatives of the miners, two mining engineers, and one representative of the Bureau of Mines.

The commission would be required to report within two years, and to make a report on general conditions of labor, safety, conservation of resources, the relation between employers and employees, and seek to "discover the underlying causes of dissatisfaction in the mining situation."

Marketing of California Oil

The proposal of the Union Oil Company of California to issue certificates for the entire amount of accredited oil in storage equal to approximately 11,000,000 bbl. at a guaranteed price of 35c. per bbl., has been accepted by the Independent Agency. The certificates will be ready for issue about Apr. 10. The Union agrees to purchase all the oil of the agency members other than itself up to 50% of the whole offered within 30 days after certification, and to carry storage oil without charge. The storage oil is to participate in current sales to the amount of 200,000 bbl. per month. This will relieve the agency of a burden of approximately $30,000 per month storage charges. Should more than 50% of the whole be offered, the acceptances will be pro-rated.

Rand Mines Blacklisted

A Reuter dispatch of Mar. 5, 1912, says that on that date in the Union House of Assembly at Cape Town, Mr. Burton, Minister of Native Affairs, said that the mortality among the tropical natives was so high in the Goerz, Eckstein, Robinson, General Mining and Rand Mines groups that the government had decided to forbid those groups further to import tropical labor.

A Visit to Porcupine

By W. R. Ingalls

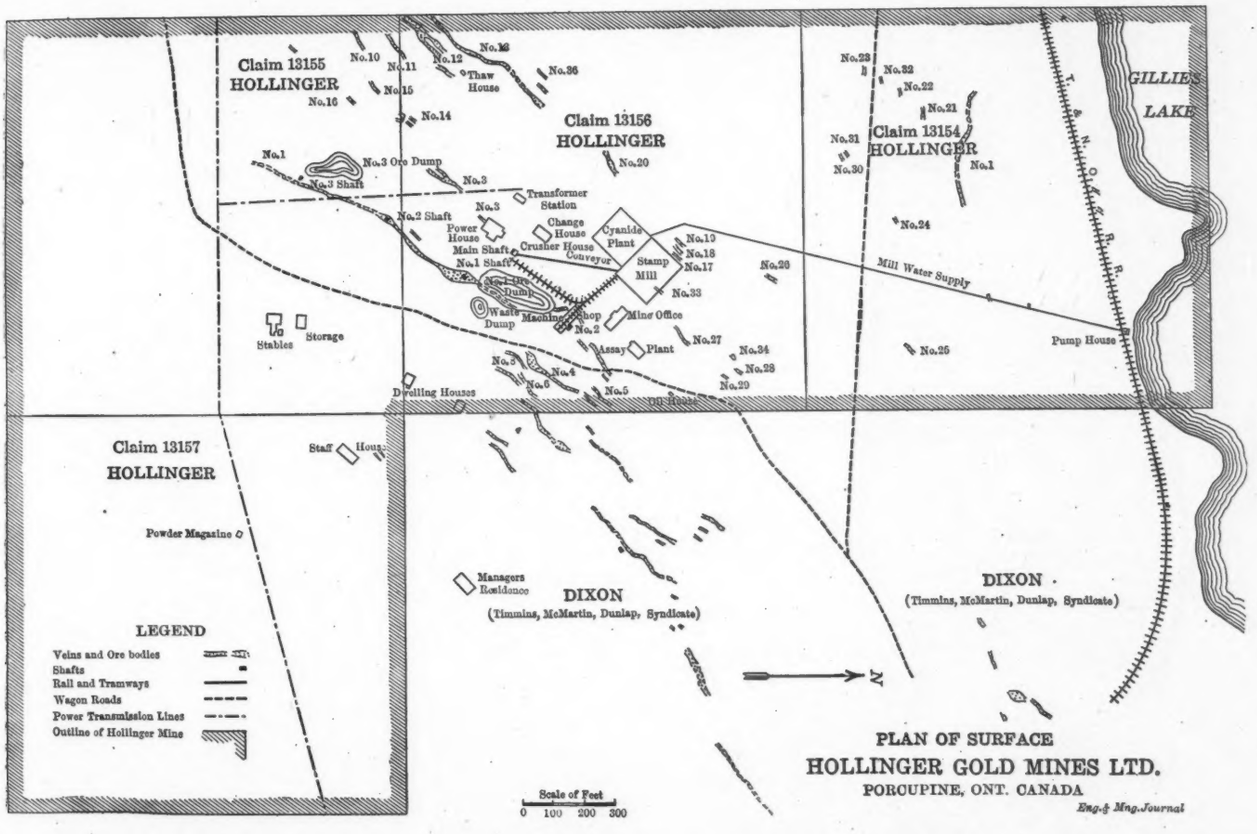
A brief account of the developments at the Hollinger and Dome mines, the mills that are under construction, and some general remarks respecting the district.

The Provincial Government of Ontario built a railway running from North Bay toward Hudson Bay, for the purpose of developing the "north country," as it is called, in an agricultural way. About 75 miles north of North Bay a cutting for the railway disclosed a vein of silver ore, which was the beginning of the Cobalt mining district. This discovery conferred great wealth upon the Ontario government, and its railway has ever since been a prosperous thing. Inasmuch as it is well recognized that "to him that hath shall be given," it was quite in the natural course of events that another mining district—Porcupine—should be discovered, northwest of Cobalt and not very far from the provincial railway, a branch from which was run into the new district last year. It is now possible to go from New York to Porcupine in a Pullman car in about 34 hours, with only one change, namely at Toronto, where a close connection is made.

Porcupine is situated on the northern side of what is called "The Height of Land," i.e., its waters flow to Hudson Bay. We are apt to think of it as being in the semi-Arctic region, but in fact it is not very far north, being only at latitude 48° 30′, and being south of the trans-continental railway line of the Grand Trunk-Pacific, now under construction. The Slocan district of British Columbia is further north, and at a much greater elevation. Although the winter at Porcupine is long and severe, there is no great hardship about it. In fact, the Hollinger and Dome mills were steadily under construction during the last winter. In summer, I am told, there is some very hot weather, and in the virgin country the mosquitoes and black flies are vexatious nuisances.

I shall not undertake to describe the geography and topography of Porcupine, nor the geology, all of which has been done repeatedly by many writers. The principal town is South Porcupine, which after destruction by fire last summer was rebuilt in a phenomenally brief time. It has the usual appearance and comforts (or discomforts) of the new mining camp, and represents the investment of considerable money, which has come from Toronto, Montreal, New York and elsewhere, with the expectation that it will be returned out of the mines of the district.

At the present time there are four mills in the district, one in operation and three under construction. The McIntyre has 10 stamps dropping. The Dome has a 40-stamp mill about ready to begin operation. The Hollinger has a 40-stamp mill under construction, and the Vipond has a plant with four Hardinge mills. All will probably be in operation before the middle of this year. The mines of the district that have large developments of ore are the Hollinger and the Dome. Nothing very definite is yet known publicly about the others.



The Hollinger Mine

The Hollinger property is owned by the Hollinger Gold Mines Limited, which is under the management of P. A. Robbins. This company in the publication of its first annual report, a few weeks ago, commendably adopted the policy of publicity, and makes no bones about showing the mine to visitors and informing them fully about it. The mineralized belt is in a shear zone of schist, which

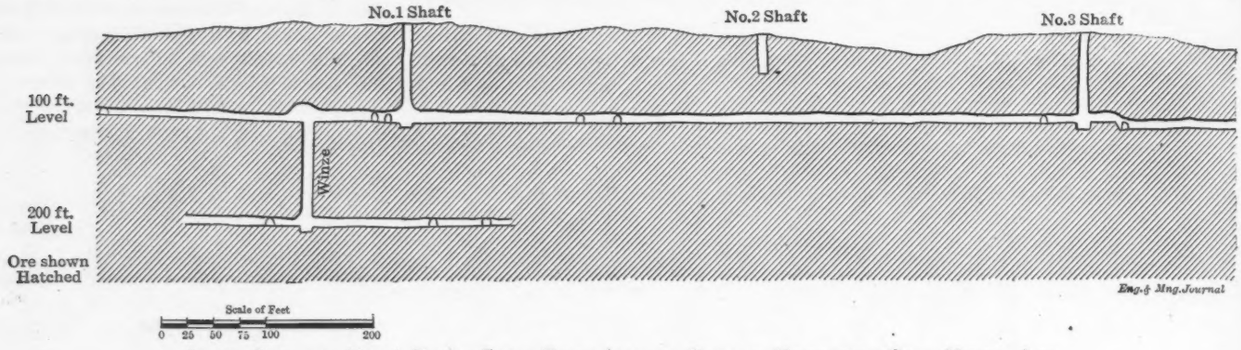
originally was probably quartz porphyry. This schist is cut by irregular veins of quartz. There are no selvages, no slickinsides and no banded structure. The quartz in a face sometimes appears as a solid mass, sometimes as blotches mingled with schist. Sometimes there is no quartz, only schist, in which event the vein can be followed only by assay. The schist in the vein is gold bearing. Sometimes there are tabular seams of quartz drooping out into the country rock, and becoming barren, although in appearance this quartz is quite like that of the vein proper. The schist is profusely mineralized with pyrite, and pyrite is also disseminated through the quartz masses. "The schist walls of the main vein do not usually carry payable values, except where contiguous to rich sections of the vein, and in such cases the schist seems to be more or less silicified, pointing to the silica-bearing solutions as having also provided the gold," says Mr. Robbins.

The property is crossed by a series of nearly parallel veins, standing nearly vertical and not very far apart. Openings have been made in the veins numbered 1, 2, 3, 4 and 8. The No. 1 vein is the main vein. According to Mr. Robbins, it has been exposed upon the surface for a distance of approximately 900 ft., averaging 9.4 ft. in width and $32.96 per ton in gold. On the 100-ft. level there is a continuous orebody for a length of 1000 ft., averaging 8 ft. in width and $31.54 per ton in gold. On the 200-ft. level the vein has been opened for a length of 350 ft., averaging 9.3 ft. in width and $49.30 per ton in gold. It is interesting to note that the wider parts of the main vein are usually the richest.

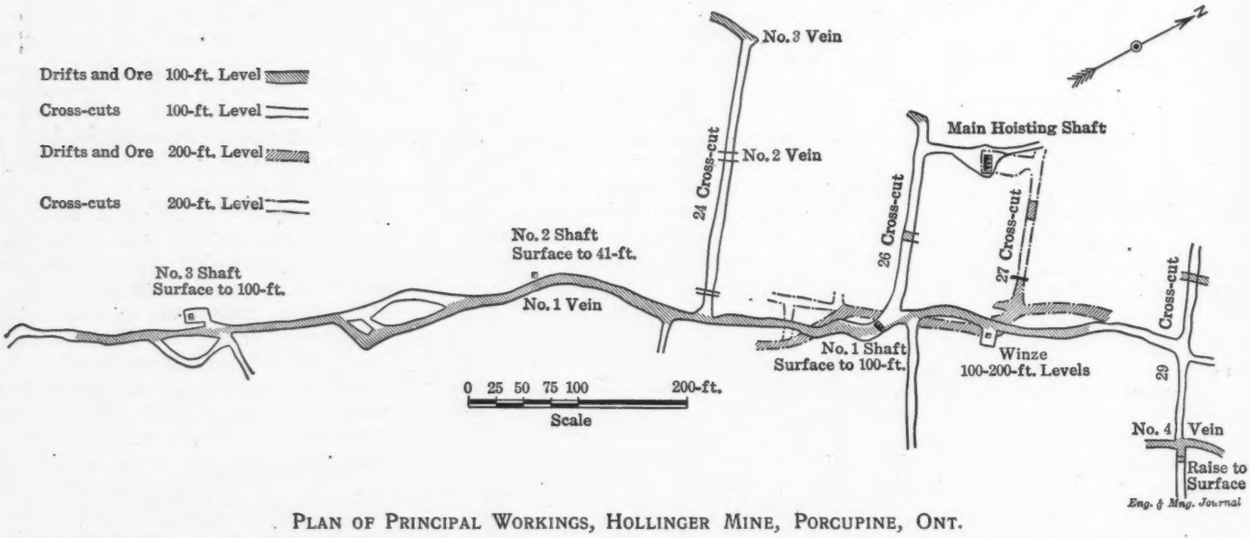
The other veins are lenticular, consisting of successions of chimneys and kidneys of quartz, which will necessitate a large amount of crosscutting and diamond drilling to discover their orebodies underground. It is also interesting to note that the pay ore goes right up to the surface. Generally speaking, the surface showing may be taken as an indication of what may be expected at depth. There is no evidence of surface enrichment.

The Hollinger mine has been sampled by Mr. Robbins and his assistants in an intelligent and conscientious way. Samples were chipped across all veins at intervals of 5 ft. In the underground workings the veins where exposed were channeled in the regulation way. Wall samples were taken by 6-ft. holes, drilled into each wall at regular intervals of 10 ft., and at intervals of 5 ft. where walls were in quartz or showed high value, the first 3 ft. and the last 3 ft. of each hole being kept as separate samples. The sampling is considered to have shown that the occurrence of visible gold does not necessarily mean payable grade, while on the contrary good ore is commonly found where no visible gold has been observed. The quartz where streaked by fine lines of pyrite in the cleavages is generally more consistent in gold content than the clear masses carrying occasional spectacular showings. It will be particularly interesting to have a comparison between mill returns and the stoping map in the case of this mine.

There is no question about the Hollinger being a real mine from which a good deal of gold will be derived. This is said without any reference to the current valuation of its shares on the market. Mr. Robbins in beginning his report declined to make a positive estimate of the ore proved by the development work, but further on indicated an expectation of 462,000 tons. The prime question is how deep does pay ore go in these veins? Steps have already been taken to sink to the depth of 400 ft. without delay. It is estimated that when the mill is completed the total investment in mine development and in plant will be about $700,000, including property to the value of $112,000 lost in the fire in 1911.



STOPE SECTION, NO. 1 VEIN—FROM FIRST ANNUAL REPORT, HOLLINGER GOLD MINES, LTD.



PLAN OF PRINCIPAL WORKINGS, HOLLINGER MINE, PORCUPINE, ONT.

The Hollinger Mill

The Hollinger mill, now under construction, is a design of A. G. Kirby, of Cobalt. The equipment will comprise 1500-lb. stamps, tube mills, Dorr classifiers, 40 Deister slime tables, four Dorr pulp thickeners, four Trent agitators, two Moore filters, two Merrill clarifying presses and two Merrill precipitation presses. Experimental tests have indicated that a high extraction of the gold in the ore may be made by a combination of concentration and cyanide treatment. The process decided upon is substantially as follows: Coarse grinding, stamping in cyanide solution, tube milling, concentration followed by amalgamation of concentrate, and cyanide treatment of both gangue and concentrate residues. According to Mr. Robbins, however, the management is not firmly tied to this process, but has given itself wide latitude in the mill for alteration. The mill building is a frame structure, the timber for it having been cut largely by the company on the ground. The initial mill will have a crushing capacity of 300 tons per day, while the cyanide plant will be capable of treating 500 tons per day. It is estimated that the cost of the mill will be $275,000. Everything in the mill will be driven by electric power, which will also be used in hoisting from the mines, this power being supplied by the Porcupine Power Co. on terms that look exceedingly favorable, considering the newness and remoteness of this district.

The Dome Mine

Everything about the surface of the Dome mine indicates a confidence in what exists underground. The houses and miscellaneous buildings are all of brick, while the mill, rock house, power house, store house, laboratory, etc., are either of steel and concrete or of steel and brick. The mill was nearly completed at the time of my visit, and very likely will be in operation before this article is printed. It comprises 40 stamps and four tube mills, and is estimated to be capable of treating between 350 and 400 tons per day. The process is substantially stamping, amalgamating on plates, sliming in tube mills, and cyanide treatment of the slime. The mill has been designed and built by the Merrill Metallurgical Co., San Francisco, and is as good an example of modern mill construction as will be found anywhere.

The Dome Mines Co. has published no estimates of the amount of ore that it has developed. The orebody at this place is of massive character, having been developed, chiefly on the 50-ft. level, over a rather large area. Eight shafts have been sunk to depths varying from 45 to 200 ft. On the 50-ft. level drifting and crosscutting have been done to the extent of 1310 ft. Prospecting to further depths has been done by diamond drilling, holes having been put down aggregating 9046 ft. In the first official report of the company it was stated that "The diamond-drill work indicates a large body of ore of good milling value, and such ore has been cut at various depths to 1000 ft. It will be necessary to do a large amount of sinking and drifting on this orebody before it will be possible to state intelligently the size of same, and what will be the average value of the ore to be milled. However, sufficient work has been done to justify the management in equipping the property with the most permanent type of buildings and machinery, with the view to extending the plant as the further development of the mine may warrant." The balance sheet of the company at Nov. 30, 1911, shows that since the beginning of operations the cost of the plant, equipment and development of the property after deducting the amount ($309,000) collected as insurance, is $860,000. By the time the plant is completed the total investment will doubtless be well over $1,000,000.

The Dome mine is in the charge of H. C. Meek, formerly of the Sudbury district, as superintendent, with Henry Hanson as mill superintendent, and W. W. Mein as consulting engineer.

General

The widespread occurrence of gold in the Porcupine district and the development of two mines that probably will be profitable (on the basis of the money that has been put into them) leads to the hope that other good mines may be developed, which hope is not unreasonable. The accomplishment during the last year has been rather wonderful, considering the setback by the fire, the hair-breadth escapes from which and the dramatic dangers, are naturally still the subject that comes easily to the tongue of the pioneers. The mining companies have taken such precautions against recurrence of loss in this way as has been possible.

At Swastika, north of Cobalt, on the main line some mining is being done, but Gowganda, Larder Lake, and the other scenes of prospecting languish from their difficult accessibility. Looking at this region broadly there seem to be chances for the discovery of numerous mines from the facts that the existence of gold, silver and nickel has been proved while but relatively little prospecting has yet been done. I mean by this that it is a promising region for the legitimate prospector. It is not a region in which gamblers in mining stocks can successfully try to pick winners. The development of two good mines and the existence of gold over an extensive area are promising. We may expect to see active prospecting in this field and also in the new country that will be opened by the Grand Trunk Pacific Railway.

Artificial Gold

The disclaimer recently issued by Sir William Ramsay, in which he definitely contradicts the rumor that he has reported favorably on a process for manufacturing gold, shows that speculators are already taking advantage of the fact that modern scientific opinion regards the transmutation of metals as an open possibility. The gradual disappearance of scepticism in this matter was explained to a representative of the London *Standard* by an eminent scientist, as follows:

The absurdity of a transmutation of metals was adopted as a scientific dogma in the eighteenth century, but since 1869 certain things that have been discovered have shown that the dogma was premature, just as it would still be premature to say that transmutation will ultimately be achieved. In 1869 the Russian chemist Mendeléeff arranged the elements in the order of their atomic weight, and from this arrangement conceived the hypothesis that they had all been evolved from some common original substance. For the elements thus arranged fell into families, each member having similar but accentuated properties as the atomic weight increased, and therefore the old idea that the simple elementary substances stood absolutely apart one from another had to be abandoned. The hypothesis that an unknown substance or element, provisionally called "protyle," underlies their differences was suggested to account for the affinities.

Now, this was a considerable revolution in opinion. The discovery of oxygen in 1774 had overthrown many conceptions previously entertained by scientists, and it had come to be supposed that the search for the transmuting "philosopher's stone," which occupied the mediæval alchemists, was an entire delusion. This "philosopher's stone" meant some substance by means of which the elements, and indeed everything, could be turned into gold, and though probably a good deal of honest research was undertaken in connection with the idea, all sorts of frauds accompanied its exploitation.

But since the whole method of mediæval science had been generally discredited—whether accompanied by honest or by dishonest experiments—the revival of the "original substance" idea in 1869 was a very considerable revolution in opinion. However, the idea of artificial gold might not have entered the minds of modern speculators at all seriously if radium had remained undiscovered. But it was found that radium undergoes a sort of spontaneous decomposition, and that among the emanations which it gives off a totally different element, namely, helium, is included.

Here, then, within the last decade science has been brought to admit by facts that a spontaneous transmutation of elements does take place in nature. Therefore scientists can no longer deny that the transmutation of such elements as lead, gold, copper, nickel, platinum, silver, mercury, cadmium and so on, and even the creation of artificial gold, are possibilities of future experiment.

However, I think one may say that scientists still maintain the improbability of this achievement, although the state of scientific knowledge as it stands at the moment seems to oppose no insuperable barrier to it. But one may speculate whether a universal method of transmutation would be discovered. It appears to me that we shall conceivably be able to note affinities between certain elements, and even to transform one into another. But the idea that gold will be the first artificial element to be constructed is probably a delusion, even if it is not a fraudulent delusion. A universal process of transmutation would throw our whole economic life into the most extraordinary quandary, and the difficulties created by the discovery of a way to make gold artificially would alone be very disastrous. But the other minor transmutations, not bearing so directly upon our standard of values, might be scientific benefits without becoming the basis of too profitable exploitations.

White Marble in Colorado

DENVER CORRESPONDENCE

In Colorado there are many deposits of white marble that will undoubtedly receive more attention as time passes and marketing facilities improve. The largest operation at present is that of the Colorado-Yule Marble Co., which has been working for six years in the development of a deposit on the Crystal River, in Gunnison County, 350 miles southwest of Denver on the western slope of the Rocky Mountain Range. The quarry was originally 10 or 12 miles beyond the railroad, and a broad-gage road had to be built from Redstone to Marble. The marble deposits consist of two mountains of fine white marble on either side of Yule Creek. The deposit is 4500 ft. long, and a depth of 230 ft. has been indicated by drill cores. It dips into the mountain at an angle of 53°. A large finishing mill, 1600 ft. long by 70 to 100 ft. in width, has been built and equipped with the latest improved machinery, including Corsi wire saws. Three quarry openings are now producing 1500 cu.ft. daily, and besides shipments to Western cities, the marble is also being used in Chicago and St. Louis.

About 17 miles east of the Colorado-Yule quarries are situated the marble deposits of the Colorado-Highland Marble Co., which was recently organized to develop 455 acres of patented land, containing white and blue-gray marble. The Colorado-Highland deposits are a part of Mt. Hayden. The company will start to work on a small scale this year, but it is the ultimate intention to construct six miles of railroad, and equip the quarries with proper machinery, and a hydro-electric plant. The company is composed, for the most part, of Denver men, J. M. Hollister being president.

Mineral Production of Great Britain

Advance proofs from the Home Department, just received, give the production of minerals in Great Britain during the year 1911 from workings coming under the Coal Mines and the Metalliferous Mines acts.

These figures do not in all cases represent the total output for the year, since quantities of some important minerals—such as iron ore, limestone, sandstone, slate and clay—come from open workings under the Quarries act, the figures for which are not yet available. All the figures are in long tons.

OPERATIONS UNDER COAL MINES ACT

The total production of coal in 1911 was 271,878,924 tons, which compares with 264,417,588 tons in 1910; an increase of 7,461,336 tons, or 2.8 per cent. The production of other minerals from workings classed as coal mines was as follows:

	1910	1911
Barium compounds ..	5,970	8,940
Clay and shale	441,786	404,223
Fireclay	2,484,069	2,482,846
Igneous rocks	374	444
Iron pyrites	8,551	8,446
Iron ore	7,979,750	7,888,898
Limestone	16,128	17,149
Oil shale	3,130,280	3,116,803
Sandstone and ganister	125,153	138,339

Changes were not considerable, the only important decrease being in iron ore.

METALLIFEROUS MINES ACT

The production of minerals from these mines may be divided into two classes, metalliferous and non-metalliferous. The production of metalliferous minerals was as follows:

	1910	1911
Arsenic	2,153	2,144
Arsenical pyrites ...	744	1,170
Copper ore and precipitate	4,160	3,244
Gold ore	6,154	2,752
Iron ore	1,851,351	1,823,795
Iron pyrites	829	1,648
Lead ore	28,493	23,864
Manganese ore	5,467	4,987
Tin ore (dressed)....	6,624	6,545
Uranium ore	76	67
Wolfram (tungsten) ore	271	260
Zinc ore	11,238	17,652

In addition to the dressed ore given above, 1721 tons of undressed tin ore were reported in 1911. The total output of iron ore from both classes of mines was 9,831,101 tons in 1910, and 9,712,693 tons in 1911; a decrease of 118,408 tons. The nonmetalliferous products were as follows:

	1910	1911
Barium compounds ..	36,979	33,610
Bauxite	3,792	6,007
Chalk	418	314
Chert, flint, etc.....	4,413	5,066
Clay and shale.....	113,022	128,470
Fluorspar	43,488	31,587
Gypsum	217,917	232,510
Igneous rocks	65,154	59,461
Lignite	.....	120
Limestone	381,067	404,705
Ocher, umber, etc...	6,339	5,592
Rock salt	205,423	210,087
Sand	12,323	16,375
Sandstone and ganister	134,044	96,292
Slate	99,514	110,608

Of the more important minerals increases were shown by clay and shale, gypsum, limestone, rocksalt and slate. There were decreases in barium compounds and sandstone.

MEN EMPLOYED AT MINES

The number of men employed at mines in 1911 was as follows:

	Coal mines	Metalliferous	Total
Underground..	863,512	17,490	881,002
On surface....	203,701	11,535	215,236
Total 1,067,213		29,025	1,096,238
Total, 1910....1,049,407		28,676	1,078,083

There was an increase in 1911 of 17,806, or 1.7%, in the number of employees at coal mines; this increase being slightly less than that in output. The increase at the metalliferous mines was only 349, or 1.2%. Taking the total number of men at the coal mines the average raised in 1911 was 258.5 tons per man.

Tasmania Mineral Production, 1910

The official returns of Tasmania for the year 1910, show a total production of £1,432,193, of which the chief items were as follows: Gold, 37,048 oz., £157,370; silver-lead ore, 51,227 tons, £247,576; blister copper and copper ore, 8864 tons, £566,972; tin ore, 3701 tons, £399,393; coal, 82,455 tons, £48,609. The state of Tasmania voted an appropriation of £200 to aid prospectors in developing their finds, on the £-for-£ principle, no single appropriation to exceed £50, but only one application was made for assistance, and after it was granted, the miner was unable to reach his destination owing to heavy rains. The Tasmania Gold Mine, Ltd., employing 533 men, produced 21,771 oz. or 59% of the gold production.

The *Boletin* de Ministerio de Agriculture of the Argentine Republic, for December, 1911, gives a full report (in Spanish) of present conditions in the Comodore Rivadavia oil fields. There is a copy, which will be loaned, on application, in the Bureau of Manufactures, at Washington, D. C.

Flume Construction in Colombia

By R. D. O. Johnson*

An account of the methods used in constructing two flumes in Colombia. Good results were obtained from native labor by planning the work so that the operations were merely mechanical. The contract system worked best.

*Mining engineer, Apartado 110, Medellin, Antioquia, Colombia.

In a region where entire dependence both for common and semi-skilled labor must be placed upon the peon, it devolves upon the engineer in charge to devise apparatus and to employ methods of work that will require a minimum draft upon the limited supply of gray matter possessed by the operatives.

Best to Plan Work for Peon

The native carpenter will perform some simple tasks, such as edging boards, as well and as rapidly as will the skilled and high-priced carpenters of the United States. But if he is called upon to read a drawing or to do much accurate measuring, the responsibility will weigh heavily upon him. His movements will become distressingly slow and the amount of work he will accomplish in a day will be so small as to render the ultimate cost of the work greater than it would have been had the high-priced carpenter from the States been imported to do the same work.

The engineer must think for the peon, even to the smaller details. The work should be rendered as simple as possible. In so far as is possible, the burden of all responsibility except that of the quantity of his work, must be lifted from his shoulders to get the best results from his labor. When from the problem of his labor every requirement has been eliminated but the necessity of machine-like movement, he can be successfully "hustled" and the product of his labor will be satisfactory both as to quantity and quality. By employing such methods the cost of carpenter work in this country will probably not be far from 30 to 50% cheaper than in the States. But give the native carpenter a blueprint, impress upon him the necessity of accurate measurement and careful work, "call him down" a few times for his mistakes and he will soon shift the scene of his labors to a mine operated under native management where the pole-and-vine method of construction is in vogue.

These observations resulted from my experience while equipping the property of the Santa Rita Mining Co. A part of the work for this company consisted in building an 800-ft. flume having the inside dimensions of 2 ft. 6 in. by 2 ft., and a 400-ft. flume having the inside dimensions 5x4 ft. The boards were all 1½ in. thick and 12½ ft. long, making the flume boxes average 12 ft. in length. The bottom of each box of the smaller flume was made up of one 12-in. board and two 10-in. boards, each side of two 10-in. boards and one 8-in. board making nine boards for each box. The number and dimensions of the boards varied in a few instances to accommodate narrower boards which were more convenient and economical to cut. Since it cost as much to edge and to handle a 6-in. board as it did a 12-in. board, the use of narrower boards was not frequently allowed.

Contract System Advantageous

All boards were sawed by hand, the sawyers working in pairs. The sawyers were at first put at day's pay, but it soon became evident that the lumber would cost $40 per M. It always pays to put the peon on contract where possible. As the peon knows nothing of the measurement of lumber by the board-foot unit and as it appeared to be a hopeless task to explain it to him, some other basis for a lumber contract had to be devised. The work of the best pair of sawyers was taken as a guide and a schedule of prices was worked out for each particular size of board or timber needed. The prices were calculated on a cost of $18 per M, the prices being raised to a small extent for the thin and narrow boards and cut down for the large boards and timbers. This scale of prices was accompanied by simple specifications as to the kind of timber acceptable, full dimensions, bark edges, worm holes, rotten spots, etc.

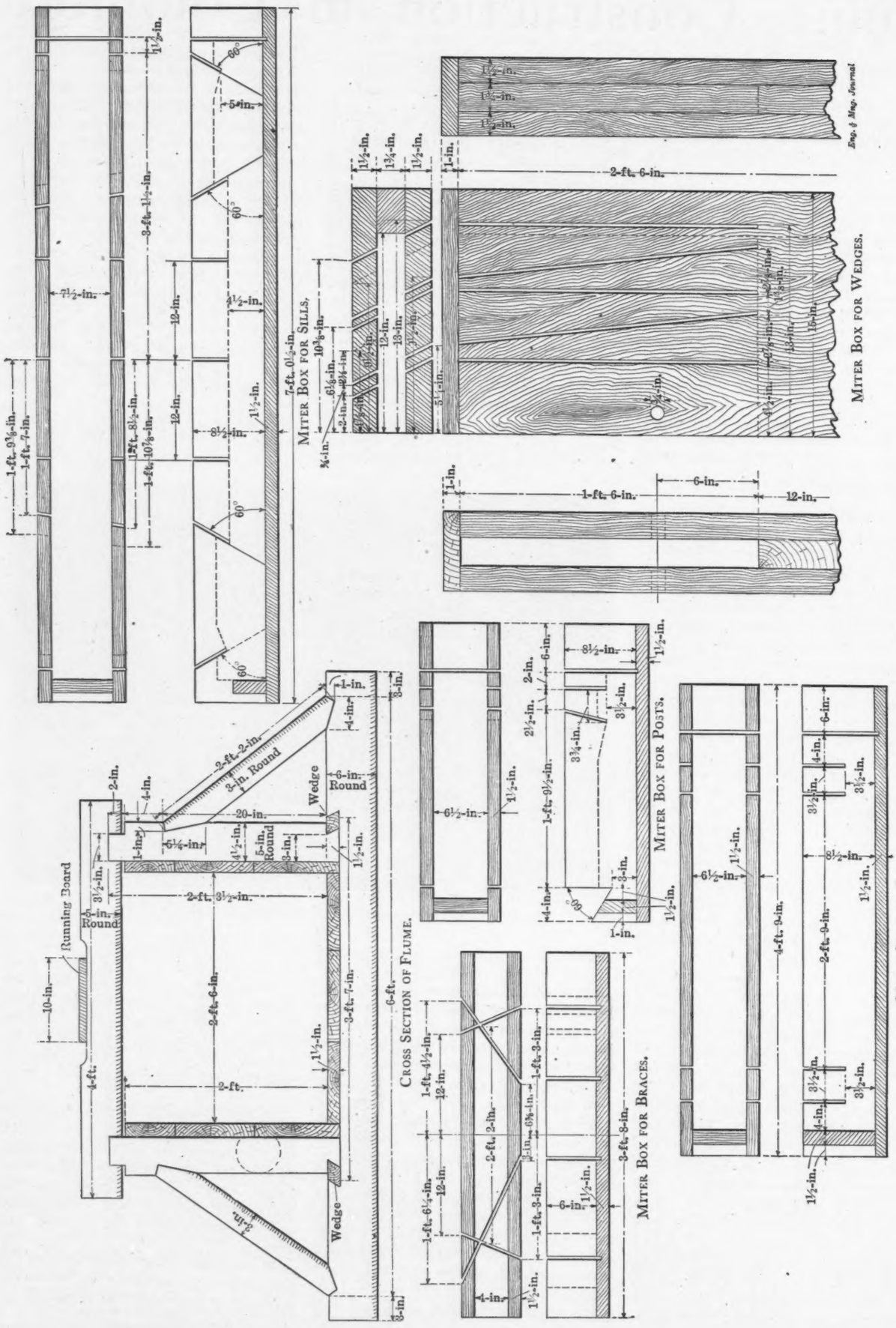
Contracts were given to each pair of sawyers for a limited number of boards and timbers on the basis of the specifications and price schedule. Each sawyer was charged 25c. gold per day for his board, the cost to the company being somewhat below this figure. It was found desirable to give small contracts rather than large ones. Boards were inspected each day and a record of the work of each pair of sawyers kept. Failure to keep to the specifications was met with the penalty of severe docking. The prices were found in practice to be about right as, on the contracts, the better sawyers could make about 50% more than the ruling day's pay for sawyers, and the poorer ones were either eliminated or had to be content with less than the ruling rate.

In searching for bunches of good trees, so that the cost in time and labor in handling the logs would be less, the sawyers would sometimes go to great distances from the sites of the flumes, making the cost of collecting the boards excessive. To obviate this difficulty a price of from one to three cents per board, depending upon the size, was added to the contract price and the sawyers were required to deliver their boards to the flume sites.

All boards were brought to dimensions and edged on a contract of 5c. per board. The boards were not tongued and grooved, reliance for tightness of the flumes being placed upon careful edging. As the boards were finished, they were marked and distributed along the lines of the flumes.

As the neighboring woods were full of small and fairly straight trees, it was determined to make the frames out of the

Preparations for Flume Construction in Colombia



Cross-section of Flume and Miter Boxes Used in Construction

round timber without even going to the trouble and expense of taking off the bark. The accompanying cross-section of the flume shows the frame, the parts of which are of much more ample diameter than the working stresses would ordinarily require, but the timber was plentiful and the large diameters made up for the bark and the weakening due to the cutting out of crooks and bends.

MITER BOXES USED IN PREPARING TIMBER

To reduce the cutting of these frames to mere mechanical operations requiring no measuring or headwork on the part of the carpenters employed in the work, I devised the miter boxes shown in the illustrations. The sills, caps and braces were cut on contract, sills 6c., caps 3c., and braces 1c. each. The cutting of the posts required the combined labor of three carpenters and was not given out on contract. The wedges were made from 1½-in. hardwood boards, 10 in. wide, and sawed into 12-in. lengths. These short sections were inserted in the wedge miter box, welded tightly, and sawed. Each 12-in. section makes four wedges, two rights and two lefts. For the total number of wedges the labor of one carpenter for six days was required.

As the sills were completed they were laid out upon the shelf excavated to receive the flume, lined up carefully, spaced and given the proper inclination on the curves. When all the boards had been sized and edged and all parts of the frames formed up and distributed along the line of the flume, four native carpenters and four helpers (peons) laid the flume at the rate of 120 ft. per day. The process was as follows:

The ends of the boards of a box were carefully fitted to the end of the preceding box already laid, the lower side boards were then spiked to the outer bottom boards; the bottom as a whole was then carefully adjusted to the centers of the sills, the posts set up and the wedges started. The center bottom board was then spiked to the sills, the lower side boards spiked to the posts, the caps placed and spiked and the wedges driven up hard. The outer bottom boards were then spiked to the sills and the braces driven into their recesses in the sills and posts and spiked. The posts were not spiked to the sills, so that the wedges could be driven up later if it appeared desirable to do so. The necessary sequence of the operations involved in laying the flume was carefully explained to the carpenters and, with a little practice, they acquired the "swing" and the work thereafter moved off at a satisfactory rate. Little calking of the flume was found necessary. Although ½x3-in. battens were provided, few were used. Exclusive of the work of excavating the shelf and on the two trestles on the line, the cost of the smaller of the two flumes was 45c. per running foot.

FLUME CONSTRUCTED BY NATIVE WORKMEN IN COLOMBIA

Leucite Hills of Wyoming

The occurrence of leucite in Wyoming is of some interest historically, for the reason that von Humboldt concluded that leucite was a mineral found only in Europe, and even as late as 1868 the general impression prevailed that it was known as a constituent of lavas at only three European localities, although it had been found in 1850 near Umria, in Persia. Since then it has been found in Asia, Africa, South America, Australia, as well as the United States. The lavas of the Leucite Hills[1] are all fine-grained rather earthy-looking rocks and in most of them a dark mica in small hexagonal plates is the only mineral that can be recognized by the unaided eye.

In general the leucite-bearing rock contains about 53% of silica, about 12% of alumina, about 11% of potash and about 6% of magnesia and of lime. It is estimated that in the various exposures on the Leucite Hills are 1,973,000,000 tons of leucite-bearing rock, which would contain about 197,000,000 tons of potash. At present this rock is of no commercial value, but a number of chemists are working on the problem of the extraction of this potash. The only grant of land in the territory covered by these deposits were the original odd sections given the Union Pacific Railroad as its original subsidy. The Union Pacific Railroad has agreed to lease under certain conditions and for certain royalties, the right after Sept. 1, 1912 to take rock for potash from several sections of this land. However, there is still Government land open to original entry in this region.

[1]Bull. 512, U. S. Geol. Survey.

Abangarez Report

The fifth annual report of the Abangarez Gold Fields of Costa Rica, operating mines in the province of Guanacaste, Costa Rica, states that during the year ended Dec. 31, 1911, there was mined and milled 42,514 tons of ore, which yielded an average of $21.84 per ton, or a total of $928,587. The cost of operation, including mine development amounting to $116,316, all repairs and renewals to equipment, and administration and marketing expense, was $721,997, leaving earnings of $206,590. The surplus for the year is $128,552, the total surplus at present being $226,050. Direct charges to profit and loss were made as follows; depreciation on surface equipment, $81,695 and $46,429, representing 5% of the gross yields, for amortization.

During the year $392,326 was spent on construction work, of which $225,635 represents the amount spent in the construction of a new power plant on the Guacimal River about 12 miles from the mill. It is expected that this power plant will be completed early this year. The completion of this plant should obviate the necessity for using the steam power plant, which, during the last season, has cost the company about $7000 per month for fuel, whenever operated.

The underground development work during the last year increased the ore reserves by 55,000 tons, after allowing for the tonnage milled. There is now approximately 340,200 tons of ore developed of an estimated average assay of $13.29 per ton, which, at the rate milled during the last year, would cover mill requirements for about eight years. While high-grade ore is encountered from time to time, the large bodies upon which the company must depend for future operation, appear to be of moderate value, and owing to the inaccessibility of the property, and the difficulties experienced in securing supplies, the cost of operation is necessarily high. It is only through the treatment of a

large quantity of ore annually, therefore, that the company can hope to handle the greater part of its ore reserve at a profit, and, with this end in view, an expenditure of $44,259 was made in additions and improvements to the mill and cyanide plants. The capacity of these plants was increased considerably, and will be further increased during the current year. It is anticipated that the cost for treatment will be materially reduced.

Lake Superior Iron Ore in 1911

The corrected report of the shipments of Lake Superior iron ore, as collected and published by the Cleveland *Iron Trade Review*, shows that shipments from the mines by rail in 1911 were 662,719 tons; making the total shipments 32,793,130 tons, which compares with 43,442,397 tons in 1910, the decrease last year being 10,649,267 tons, or 24.5%. The shipments by ranges, as compared with 1910, were:

Range	1910	1911	Changes
Marquette	4,392,726	2,833,116	D. 1,559,610
Menominee	4,237,738	3,911,174	D. 326,564
Gogebic	4,315,314	2,603,318	D. 1,711,996
Vermillion	1,203,177	1,088,930	D. 114,247
Mesabi	29,201,760	22,093,532	D. 7,108,228
Cuyuna		147,431	I. 147,431
Baraboo	91,682	115,629	I. 23,947
Total	43,442,397	32,793,130	D. 10,649,267

The Cuyuna range appeared in 1911 for the first time, the shipments being from the Kennedy mine of the Rogers-Brown Iron Co. There were 184 shipping mines in 1911, compared with 196 in 1910. Of the shipping mines last year 90 were on the Mesabi Range; 38 on the Menominee, 29 on the Marquette, 17 on the Gogebic, 7 on the Vermillion, 2 on the Baraboo and one on the Cuyuna.

The total shipments of ore from the beginning, with the year each range was opened, are given as below:

Range	Year Opened	Total Tons	Per Cent.
Marquette	1850	99,129,831	18.9
Menominee	1877	79,361,967	15.1
Gogebic	1884	67,739,135	12.9
Vermillion	1884	31,417,492	6.0
Mesabi	1892	246,998,726	46.9
Baraboo	1903	1,087,938	0.2
Cuyuna	1911	147,431	....
Total		525,882,510	100.0

The Marquette and Menominee ranges are in Michigan; the Gogebic partly in Michigan and partly in Wisconsin; the Baraboo in Wisconsin; the Vermillion, Mesabi and Cuyuna in Minnesota.

In addition to the shipments given above there were 135,306 tons shipped in 1911 from Canadian mines in the Lake Superior district; 128,628 tons from the Helen in the Michipicoten Range, and 6678 tons from the Moose Mountain.

The largest shipper in 1911 was the Hill, only in its second year. Six mines, all on the Mesabi, shipped over 1,000,000 tons each—the Hill, the Canisteo, the Dale, the Leonard, the Mahoning and Sauntry-Alpena.

Steel Corporation Shipments

The shipments of the Oliver Iron Company, the mining subsidiary of the Steel Corporation, in 1911 were 17,282,499 tons, or 52.7 per cent. of the total. Nearly one-third of this tonnage came from mines on the Hill leases, which shipped in all 5,499,759 tons. This was 1,729,759 tons more than the agreed minimum for the year; but the corporation was still behind at the end of the year. The total minimum requirements up to the end of the year were 11,250,000 tons; the total mined up to that date was 7,832,138 tons, leaving 3,417,862 tons to be made up. The minimum for 1912 is 4,500,000 tons, so that 7,917,862 tons must be mined this year to come out even.

The great attention given to the Hill leases combined with the general falling off in shipments to make some remarkable changes in the older mines of the corporation on the Mesabi. The Adams decreased from 1,258,295 tons in 1910 to 411,268 in 1911; the Burt from 1,032,815 to 56,506; the Fayal from 1,485,099 to 434,364; the Morris from 1,364,673 to 40,481 tons. The Hull-Rust, which was the leader in 1910 with 3,189,975 tons, fell to 495,977 tons in 1911. These changes were not due to any trouble at the mines; they were made because it was less costly to take the ore from the Hill mines and thereby avoid the payment of heavy minimum royalties on ore not mined.

The Old Ranges

On the Gogebic, the most noteworthy changes were the decreased productions of the Newport and the Norrie group. On the Menominee, marked decreases are shown by the Baltic, Florence and Loretto, while the Riverton group and the Zimmerman made handsome increases. On the Marquette, the Cleveland-Cliffs group declined from 955,374 tons to 344,950 tons, and the Maas from 208,103 tons to 24,927 tons. The Negaunee declined from 348,818 tons to 140,406 tons, making the lowest production since 1900. On the Vermillion the Sibley production fell from 206,386 tons to 1899 tons, while the Zenith increased from 283,320 tons to 448,295 tons, making the highest production in its lifetime of 20 years.

Titanium and Vanadium Alloys

The American Iron & Steel Association reports that during the calendar year 1911, 3,679,335 lb. (1643 gross tons) of ferro-titanium alloy were shipped by an American producer to 79 manufacturers of steel in the United States. Of the total quantity shipped, 20 plants, which make ingots but not castings, purchased 525,295 lb.; 44 plants, which make castings but not ingots, purchased 136,425 lb., and 15 plants, which make both ingots and castings, purchased 3,017,615 lb. In addition, 129,440 lb. were exported. The average consumption of ferro-titanium in the manufacture of steel is about 0.4 per cent., or about 8.96 lb. per gross ton.

The association also learns from the Vanadium Sales Co. of America that in the calendar year 1911, it shipped 689,510 lb. of ferro-vanadium to 57 plants in the United States and Canada which manufacture steel ingots or castings.

Asbestos in the United States

The production of asbestos in the United States is rapidly increasing, says J. S. Diller in a U. S. Geological Survey report. It more than doubled in 1911 and the increase was largely in fiber of the serpentine (chrysotile) variety, of which the best grades are spun and woven into fireproof fabrics for theater curtains, motor-brake bands, and the like, where incombustible material must be used. The finest asbestos thread yet spun carries a small percentage of cotton and runs over 2 miles to the pound.

The total production of asbestos in the United States in 1911 was 7604 tons, valued at $119,935, and it came almost wholly from Vermont and Georgia. A little came from Wyoming and Virginia. Canada, however, produced 13 times as much asbestos in 1911 as the United States, and we imported for our manufacturers 62% of all Canada produced and 83% of all exported.

One of the features of the asbestos industry in recent times is the growth of the demand for the lower grades. Being fireproof and an electric and heat insulator, asbestos is extensively used in the building arts, and the interest in this sort of manfacture at a number of points throughout the country indicates that the industry is developing rapidly. The most striking new application of asbestos was made last September in Louisiana, in extinguishing a burning oil well from which 40,000 barrels of oil were escaping daily.

The finest asbestos yet found in the United States, comparing favorably with the best from any part of the world, is in the Grand Cañon of the Colorado in Arizona; it is not, however, easily accessible.

The Peruvian vanadium deposits, the vanadiferous sandstone deposits of southwestern Colorado and the carnotite deposits of Colorado and Utah all occur in the Jura-Triassic sedimentary rocks. Chromium-stained sandstone beds frequently accompany the vanadiferous sandstone and carnotite deposits of Colorado and Utah.

Electrolytic Dissociation and Solvation

By Harry C. Jones*

All substances which form electrolytes on dissolving partially decompose in solution; further, all solvents form compounds ("solvates") with the dissolved bodies.

*Professor of Physical Chemistry, Johns Hopkins University, Baltimore, Md.

It has been seen how Van't Hoff showed that the laws of gas pressure apply to the osmotic pressure of solutions of non-electrolytes.

Osmotic Pressure a Simple Function

The young Swedish physicist, Arrhenius, was at this time working in the laboratory of Ostwald in Leipzig, and a little later in that of Van't Hoff, in Amsterdam. In the application of Boyle's law for gases to the osmotic pressure of solutions, Arrhenius recognized this fact that the osmotic pressure exerted by a solution is a function only of the ratio between the number of parts of the dissolved substance present and the number of parts of the solvent. Osmotic pressure is, then, an arithmetical property, depending only upon numbers.

This being true, when we have too great osmotic pressure we must of necessity have too great a number of parts present. There was no escape from this conclusion. Since electrolytes, *i.e,* acids, bases and salts, exert too great osmotic pressure in terms of the number of molecules of these substances present in solution, we are forced to conclude that these molecules break down into parts.

The question, however, was into what do the molecules of such apparently stable substances as hydrochloric acid, potassium hydroxide or potassium chloride break down in the presence of water? They obviously could not break down into the atoms of which these molecules are composed, since these atoms are known to act upon water and some of them, like potassium, with violence; while no such reaction manifests itself when an acid, base or salt like those referred to above is thrown into water.

This was the difficulty which Arrhenius encountered. On referring to the literature bearing upon this problem he found one paper which was helpful. It is electrolytes which show these abnormally great osmotic pressures. Electrolytes in aqueous solution conduct the current, therefore, any suggestion that is proposed to account for these large osmotic pressures must also account for the phenomena of electrolysis, since these are but different properties of the same solutions.

The View of Clausius

The great German physicist who contributed so much to the science of thermo-dynamics—Clausius—had advanced the following hypothesis to account for the facts that were known at his time in connection with electrolysis. It had been shown that an infinitely weak current can electrolyze water to which an acid had been added. Water is one of the most stable compounds known to man, shown in part by the large amount of heat liberated in its formation, which is a good general criterion of the stability of the product of a reaction; and shown further by the fact that high temperatures are required to break water down into its elements—3000° F. being required to decompose half of it into hydrogen and oxygen.

It is a simple matter to show by calculation that an infinitely weak current can never decompose even a single molecule of water, still less enough water to liberate a cubic centimeter of electrolytic gas. To account for this and similar facts Clausius found it necessary to assume that some of the parts in the acidulated water were already broken down into hydrogen and oxygen. The current simply exerted a directing influence on those parts, driving the positively charged to the cathode and the negatively charged to the anode, where they give up their charges and escape as hydrogen and oxygen gas.

Since these parts carried the current they must be charged electrically, and such electrically charged parts in solution, Faraday had called ions or wanderers.

This was the starting point for Arrhenius. It was only necessary to assume that the molecules of the acid, base or salt each break down into two charged parts to account for the abnormally great osmotic pressures exerted by these substances. Each molecule breaks down into a positively charged part or cation and a negatively charged part or anion as follows:

$$HCl = \overset{+}{H}, \overset{-}{Cl}$$

$$KOH = \overset{+}{K}, \overset{-}{OH}$$

$$KCl = \overset{+}{K}, \overset{-}{Cl}$$

There are thus twice as many parts present in the solution as if the molecules were not broken down into atoms. This is the origin of the theory of electrolytic dissociation in solution.

Quantitative Basis for the Theory.

Arrhenius, of course, went much farther than this purely qualitative stage. He worked out methods for measuring quantitatively the amount of the dissociation in solutions which are not sufficiently dilute to be completely dissociated. He furnished a large amount of evidence for the correctness of his theory, and pointed out in advance some of the objections which would be offered to it, and answered them; and this all in his first paper on the subject published in vol. 1 of the *Zeitschrift für physikalische Chemie,* p. 631—the same volume in which Van't Hoff's great paper had been published. He would formulate these two great generalizations found for solutions as follows:

The combined expression of the laws of Boyle and Gay-Lussac for gases is—

$$pv = RT$$

p, is pressure, v, is volume, R, is the gas constant and T, the absolute temperature of the gas. Since these laws apply to the osmotic pressures of solutions of non-electrolytes, the above equation holds for the osmotic pressures of solutions of these substances.

That the equation may be applied to the osmotic pressures of electrolytes, Van't Hoff showed that it was necessary to introduce a coefficient, and the equation then became—

$$pv = iRT$$

The coefficient i was always greater than for electrolytes. The meaning of this coefficient i was what Arrhenius explained by the theory of electrolytic dissociation[1].

Almost as soon as these generalizations were reached, all kinds of objections were offered to them—sensible and senseless—with a large preponderance of the latter. It would lead us far afield to discuss even the more important of these. Suffice it to say that practically every one of these objections has been satisfactorily answered, and these generalizations have done far more than prove themselves. They have predicted a vast number of facts and conclusions which have been verified as the result of subsequent work; and this is the first test of the validity and value of any generalization.

We might conclude then, from what has thus far been said, that the applicability of the gas-laws to the osmotic pres-

[1] i in this formula has not its ordinary engineering meaning, $\sqrt{-1}$.

sure of solutions of non-electrolytes, and the theory of electrolytic dissociation to explain the results presented by electrolytes, gave us a complete theory of solution, but such is far from the case. These generalizations are necessary but not sufficient.

The generalizations in question hold only for very dilute solutions; for solutions which are far more dilute than those used in the scientific laboratory. Or, as it has been remarked, these generalizations apply only to homeopathic solutions.

A theory of solution to be of the highest scientific value must be a theory not simply of very dilute solutions, but of solutions in general; and must hold especially for those solutions which are used by the chemists and other men of science. This failure on the part of the generalizations reached by Van't Hoff and Arrhenius was quickly recognized and early pointed out; and no satisfactory answer could be given to it. The matter stood thus for a number of years, and it is only in the last decade that the explanations of why it is that these generalizations do not apply to solutions of even reasonable concentration, has been furnished.

Solvate Theory of Solution

In 1898 a Japanese, Ota, came to my laboratory. Being a mature chemist, I put him at once upon a problem in research. When substances in general are dissolved in liquids the freezing-points of the solvents are lowered. This is well illustrated by the freezing-point of water. This, which is one of the most fundamental properties of solutions, is usually characterized as the lowering of the freezing-point of the solvent by the dissolved substance.

This property had been elaborately studied as far as dilute solutions are concerned, and the change in the lowering of the freezing-point of the solvent with the dilution of the solution was well known. As the dilution of the solution increases the dissociation increases, and since an ion produces the same lowering as does a molecule, of the freezing-point of a given number of molecules of the solvent, the more dilute the solution the greater the molecular lowering of the freezing point of the solvent. By molecular lowering is meant the lowering actually observed on the thermometer, divided by the concentration of the solution expressed decimally in terms of a normal solution.

In a word, the molecular lowering of the freezing-point of a solvent by a dissolved substance, should increase with the dilution of the solution, from the most concentrated to the most dilute.

Ota, almost at once, obtained results directly at variance with this conclusion. He measured the freezing-point lowerings of fairly concentrated and of very concentrated solutions of salts in water, and found that the molecular lowering instead of increasing with the dilution from the most concentrated to the most dilute solution, passed through a decided minimum at a certain concentration. From this concentration the molecular lowering increased with the dilution, but what was apparently abnormal and certainly unexpected, was that from this concentration the molecular lowering also increased, and increased very rapidly with the concentration of the solution.

This was a surprising result, and entirely inexplicable in terms of anything known at that time.

We did what is usually done in such cases, at first we did not believe the results. We thought that some error had been made in the work, and repeated the work from beginning to end, but always with the same result. After several repetitions we were forced to accept the results, and then the important point was to explain them.

Working Hypothesis

Before reaching any final conclusion as to the cause of these unexpected results, the first question was to see how general the phenomenon was. Was it shown by only a few substances, and if so, of what kind, or was it a general property of dissolved substances? This could be answered only by a vast amount of experimental work, dealing not with all compounds, since this was impossible; but with all types of chemical compounds.

The result was that after studying somewhat more than a hundred typical substances, and somewhat more than a thousand solutions of these substances, we were justified in stating that concentrated solutions of nearly every type of chemical compound, produced lowerings of the freezing-point of water that were too great in terms of any theory or generalization that up to that time, had been proposed.

The molecular lowerings in concentrated solutions were not only greater than the values calculated from the theory of electrolytic dissociation, but in some cases many times greater. Thus, take a certain very concentrated solution of calcium chloride, the calculated molecular lowering was 2.83° while the molecular lowering found experimentally was 14.32°. The value found experimentally was about five times that calculated from theory.

To take another example. The molecular lowering calculated for a certain concentration of aluminum chloride is 2.88° while the value found experimentally was 21.18.° The experimental value is about 7.4 times the theoretical.

It was obvious from such results that here was something which must be taken into account in dealing with the nature of solution.

Having found that we were dealing here with a general phenomenon, the question, then, that must be answered is what is its meaning? How are we going to explain such abnormalities as those just discussed?

It was found by the French chemist Raoult at Grenoble, that the lowering of the freezing-point of a solvent by a dissolved substance is, like osmotic pressure, an additive property. It depends only on the ratio between the number of parts of the solvent and of the dissolved substance.

This being true, the following explanation of the above results is possible. If the dissolved substance combines with a part of the liquid, forming more or less definite chemical systems with it, just so much of the liquid is removed from the field of action as far as solvent is concerned. The solution is thus rendered more concentrated than we would suppose from the total amount of solvent liquid and dissolved substance present, since a part of the liquid is not playing the *rôle* of solvent, but is in combination with the dissolved substance. There being less solvent present than we would suppose, its freezing-point is lowered more than if all the liquid present were acting as solvent.

When I offered this possible explana- of the results in 1900, I did not believe it was the *true* explanation, and set about to prove its invalidity; but with the result of adding a large amount of confirmatory evidence of its general correctness.

Lowering of Freezing-Point and Water of Crystallization

The first line of thought that suggested itself in connection with the validity or incorrectness of this suggestion was the following. If dissolved substances combine with more or less of the water they form hydrates, and the complexity of the hydrates would vary with the dilution of the solution and with the temperature. Water of crystallization can be looked upon as water of hydration. It is simply the amount of water that the salt can bring with it out of solution and hold in fairly stable equilibrium at ordinary temperatures. This amount bears a simple relation to the amounts of water with which they are combined in solution, i.e. there should be a relation between the amounts of water with which salts combine in solution, and the amounts which they bring with them out of solution as water of crystallization. Since the lowering of the freezing-point measures the amount of water of hydration in solution, we would expect a simple relation to manifest itself beween

freezing-point lowering and water of crystallization, if the suggestion of hydrates to account for the abnormal freezing-points of aqueous solutions was true.

Water of Hydration and of Crystallization Simply Related

Here was a more or less crucial test of the hydrate conception. It was only necessary to measure the freezing-point lowerings of a number of concentrations of a large number of compounds with different amounts of water of crystallization, and then compare the freezing-point lowerings with the water of crystallization of the several compounds.

The proper way in which to make such comparisons would be to take all of the chlorides studied, and compare their freezing points with their water of crystallization. Then compare all of the bromides with one another with respect to freezing-point lowering and water of crystallization. In a similar manner the iodides should be compared, and the nitrates are especially important in this connection, since, on account of their general solubility a large number of them were studied. If we plot the following curve diagram the relations in question come out very clearly.

Let the abscissas be concentrations of the solution and the ordinates molecular lowerings of the freezing-point.

The nitrates which crystallize with no water—sodium, potassium and ammonium—fall near the bottom of the diagram; i.e., produce only small lowerings of the freezing-point of water; indeed, the value found is only slightly greater than the calculated lowering.

Next in order, passing up the diagram is lithium nitrate with two molecules of water of crystallization. Then comes the nitrate of calcium with four molecules of water, and then a number of nitrates, each with six molecules of water of crystallization. The curves for all of these substances occupy nearly the same position, just as they would be expected to do, since they all crystallize with the same amount of water. They would, therefore, be expected to combine with nearly the same amounts of water in solution, and, consequently, to give approximately the same lowerings of the freezing-point of water.

When we pass to the nitrates of aluminum, iron and chromium, with eight and nine molecules of water of crystallization, we find their curves near the top of the diagram, showing greatest freezing-point lowerings and, consequently, greatest hydration in solution. Again, this is just what would be expected from the large amounts of water with which they crystallize.

If we examine this diagram we see that there is not a single exception to the relation between water of crystallization and lowering of the freezing-point, that is to say not a single exception among the nitrates to the relation between the amounts of water which substances can bring with them out of solution, and the amounts of water with which they combine in solution.

In a similar manner the freezing-point curves for the chlorides were plotted, and the relations brought out here were just as satisfactory as for the nitrates. The chlorides fell in the same order with respect to water of crystallization and with respect to freezing-point lowering or water of hydration in solution.

What has been said in reference to the nitrates and chlorides, holds equally well for the bromides and for the iodides.[1]

When this evidence came out we had to accept at least tentatively, the suggestion that had been made to account for the large freezing point lowerings produced by concentrated solutions.

Other Lines of Evidence

About a dozen independent lines of evidence were soon discovered, which bore directly or indirectly on this problem, but they cannot be discussed here. Any one who is sufficiently interested in this phase of the work can find them in vol. 60 of the publications of the Carnegie Institution of Washington, which generously supported this investigation with financial aid[2].

Every one of these lines of evidence, without a single exception, pointed to the correctness of the conclusion that when salts are dissolved in water they combine with more or less of the water present.

The evidence was so overwhelming in quantity and unambiguousness that there was nothing left but to accept the correctness of the hydrate conception.

A method was worked out for calculating the approximate composition of the hydrates found by the various substances at the different dilutions[3].

Theory of Solvation

Having shown, then, that when substances are dissolved in water they combine with a part of the water—form hydrates—the question naturally arose, has water a monopoly of the power to combine with dissolved substances? Or do other solvents also combine with substances dissolved in them.

It is impossible to use the freezing-point method with, for example, the alcohols and many other solvents. They freeze at temperatures that are too far removed from the ordinary to measure accurately. There is, however, another method, utilizing another arithmetical property of solutions, which can be applied to just such problems. When solids are dissolved in liquids the boiling points of the solvents are raised. The amount of the rise is dependent only upon the ratio between the number of parts of the solvent and of the dissolved substance, just as freezing-point lowering depends upon this same ratio.

Knowing the dissociation of the substance in the solvent in question, we have seen that we can calculate the freezing point of its solutions. Just so we can calculate the boiling points of solutions, and, consequently, the rise in the boiling-point of the solvent produced by the dissolved substance.

We can then measure the rise in the boiling point of the solvent, and see whether the results of calculation agree with those of experiment. It was soon found that they do not. The value found experimentally was greater, and in some cases much greater than that calculated.

Just as we interpreted abnormally great lowering of the freezing point of water as due to hydration, just so we interpret abnormally great rise in the boiling points of non-aqueous solvents, as due to a combination between the solvent and the dissolved substance; in a word, the hydrate conception becomes for solvents in general the theory of solvation.

Absorption Spectra of Solutions

There is just one other line of evidence bearing upon the solvate theory of solution, which will be referred to briefly, because of the importance and unambiguous character of the conclusions drawn from it. In arriving at the conclusion already drawn, it should be stated that one phase of the work alone involved making about 40,000 conductivity measurements.

The work on the solvate theory of solution, for the last seven years, has had to do largely with the power of solutions to absorb light, and about 6000 solutions have been studied from this standpoint.

What does absorption of light by solutions really mean? When white light falls upon a colorless solution, none of the wave lengths of ether that constitute white light find anything in the solution which they can throw into resonance with themselves. They all pass through the solution practically unabsorbed. If, on the contrary, the solution is colored it means that some of the wave lengths of light find something in the solution which they can set vibrating in resonance with themselves. They do so, their energy being expended in setting up

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[1]See "Elements of Physical Chemistry," by H. C. Jones, fourth edition, pp. 238-239.

[2]Cf. Amer. Chem. Journ., Vol. 41, p. 19 (1909), and Zeit. für phys. Chem., Vol. 74, p. 325 (1910).

[3]"Hydrates in Aqueous Solution," publication No. 60 of the Carnegie Institution of Washington.

these new vibrations; they are consequently stopped; the remaining wave lengths pass on through, and the color of the solution is due to the waves of ether of visible wave length that are unable to set up resonance in the solution.

In a blue solution the long wave lengths of light set up resonance and are stopped. In a red solution the short wave lengths of light set up resonance and are stopped.

A moment's thought will show how such a method can furnish evidence for or against the solvate theory.

If the dissolved substance is combined with some of the solvent it is almost certain that it would have different resonance than if free and unconfined. If, by any means we could change the degree of solvation of a colored substance in solution, we ought to be able to detect a corresponding change in the absorption spectrum of the solution.

We are especially well equipped in my laboratory for this kind of work, since we have at hand a suitable concave grating; and the Carnegie Institution has very generously aided us in this field of investigation.

There are a number of ways in which the degree of solvation of a solution can be changed. It can be increased by increasing the dilution of the solution, or lowering its temperature. The solvation can be decreased by increasing the concentration of the solution, by adding a dehydrating agent, by raising the temperature, etc.

Every one of these changes has been followed by a corresponding change in the absorption spectrum of the solution in question.

Absorption Spectrum Depends on Solvent

Just one other bit of spectroscopic evidence will be referred to, because it bears so directly upon the problem in hand. If a substance dissolved in several different solvents combines with the solvents in question forming solvates, then these different solvates will, of course, have different compositions. These different solvates of the substance in question would be expected to have different resonance or different absorption spectra. An examination of the literature when we began our work showed that everything which had been done up to that time negated the above conclusion. It was thought that a substance dissolved in different non-absorbing solvents, always had the same absorption spectrum.

The evidence obtained at that time in favor of the solvate theory was so overwhelming that we did not believe the above statement and hence took up the study of this problem.

Doctor Anderson and I soon found an example of just what we expected. Neodymium chloride dissolved in water had a different absorption spectrum than when dissolved in methyl or ethyl alcohol. This result, with the spectrum plate, is published in vol. 110 of the publications of the Carnegie Institution of Washington.

Since that time, Doctor Strong and I have found so many examples of the effect of the solvent on the absorption spectra of solutions, that it would require too much space even to cite them. We have even been able to detect the difference between the absorption spectrum of a substance in an alcohol, and in its isomer[4].

The spectroscopic evidence due to the investigations of my co-workers, Uhler, Anderson, Strong and Guy is so voluminous, direct and convincing, in favor of the view that dissolved substances combine with more or less of the solvents in which they are dissolved, that, taken with the other evidence, there is at present scarcely any room for doubt as to the general correctness of the solvate theory of solution.

Value of the Solvate Theory of Solution

If the solvate theory of solution is true, the question then arises of what use is it? In the first place, is it antagonistic to the theory of electrolytic dissociation or in harmony with it? It should be stated emphatically that it is in perfect harmony with the generalizations of Van't Hoff and Arrhenius. The latter showed us that electrolytes in the presence of water are broken down into charged parts of ions. The theory of electrolytic dissociation said simply that ions exist in solution without telling us whether or not they are combined with any of the solvent. Indeed, the assumption has generally been made that they were not thus combined—that the ions are "dry," even in the presence of water; and we have seen that the theory in this form applied only to very dilute or "ideal" solutions. If the molecules and ions are combined with any of the solvent, it is obvious that this must be taken into account, otherwise we do not know the real concentration of the solution. Thus, a solution of aluminum chloride prepared by dissolving a gram-molecular weight of the salt in water and then diluting to the volume of a liter is what we ordinarily term a "molecular normal" solution. The freezing-point lowering shows that under these conditions nearly three-fourths of the water is combined with the dissolved substance, and that the solution is really about four times as strong as we have thought it to be.

It is obvious that no theory could apply to a solution four times as strong as we supposed, unless it took this fact into account. The important point is that when the theory of electrolytic dissociation is supplemented by the theory of solvation we have a theory of solutions—of the solutions with which we have to deal in the scientific laboratory—a theory of the solutions which give us natural science.

Importance of Solution

What has been said raises the further question, which, in a sense, is the most important of all. Of what scientific or technical value is that condition of matter which we call solution? Why have men of science striven so long and arduously to learn what is the real nature of solution?

It is because solution is incomparably the most fundamental and important condition of matter. This has already been referred to, but more stress should be laid upon it now that we know something of the nature of matter in the dissolved state.

All chemistry is but a branch of solution in the broad sense in which that term is now used, and which will be discussed a little later. Matter in the pure homogeneous condition is practically inert chemically. It is only when mixed with matter of some other kind—when in solution—that it becomes active. The meaning of this will become clearer when we learn the broad sense in which the term solution is now used.

Solution is almost as important for geology as for chemistry. Many of the rocks were deposited from solution, and a great many rocks were formed from aqueous suspensions; and then take the igneous rocks, these are formed from molten magmas, which are solutions at high temperatures.

Take the biological sciences. We are accustomed to say "without carbon, no life." We could just as well say "without water, no life." Solution is undoubtedly fundamental to most of the biological sciences, if for no other reason, because it is fundamental to life itself. Physiology, pharmacology, botany are all dependent for their existence upon solution, and some of the branches of physics are vitally connected with it.

Without going into any further detail, enough has already been said to justify the statement that solution is the most important condition of matter known to man. And this justifies the stress that has already been laid upon it.

The generalizations discussed above are not the only ones that lie at the basis of modern physical chemistry. There is the Phase Rule discovered by

[4]Cf. Nos. 160 and 160, Publications of the Carnegie Institution of Washington.

one of our own countrymen, a thoroughly great and characteristically modest man of science, Willard Gibbs. And then the application of Faraday's law of electrolysis to chemical valence; indeed, the explanation or scientific interpretation of valence in terms of Faraday's law, is a fundamental matter.

The scope of these papers will, however, scarcely allow of a discussion of these generalizations; at least not of the former. The latter may be taken up briefly, later. Those generalizations already considered at some length lie at the basis of all of the modern developments in physical chemistry. The remainder of these papers will have to do more or less with their applications to special problems.

New Diamond Diggings in the Transvaal

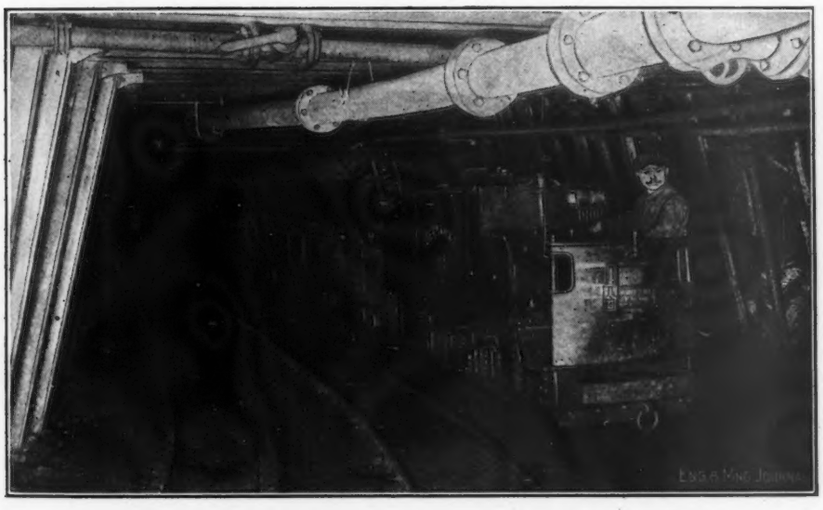
Owing to the exaggerated reports of the new alluvial diamond fields in the Bloemhof-Mooifontein district, Transvaal, which may attract Americans to South Africa, Consul Edwin N. Gunsaulus, of Johannesburg, has reported on the finds (*Daily Consular and Trade Reports*, Feb. 3, 1912.) The original field was near Bloemhof, a small village on the Vaal River, about 200 miles south of Johannesburg. The surface gives no indication of the diamonds, the gravel everywhere being hidden by a cloak of soil, usually, however, only 6 in. to 1 ft. thick. The diamond-bearing gravels at first sight resemble a bed of dirty potatoes, with few big boulders. The most characteristic stones are banded ironstone pebbles; known as the Bloemhof "bantams." Most of the diamonds are small, and in the six months ended Sept. 30, 1911, the output was 10,575 carats, of $286,000 value.

The original area at Mooifontein, 17 miles from Bloemhof, was thrown open Sept. 13, 1911, and it is estimated that there are at least 10,000 white diggers at work, and as many Kaffirs. With an output of $160,000 per month, the average yield per digger would be about $8. Consequently, despite the great area of the diggings, probably over 11,000 acres, it seems foolish to go expecting to make a fortune. Sanitary conditions are bad, and it seems probable that it will be highly dangerous for unacclimated whites during the hot season.

The Otto Internal Combustion Locomotive

By J. B. Van Brussel*

The Germania mines, of the Gelsenkirchener Bergwerks Aktiengesellschaft, have recently put into service their sixty-ninth Otto locomotive. These locomotives furnish a haulage power, varying from 6 to 60 hp., and are driven by strongly built, horizontal Otto engines, running either on gasoline, benzol, alcohol (or, if above ground, also on petroleum), carried upon a frame provided with a pair of springs above each driving axle. The power is transmitted to the axles by gear wheels or by chain gear, put in and out of action by means of friction clutches. The exhaust gases are condensed in a way which insures that no foul air can infect the galleries. The safety of this form of tractor is so far recognized that it is admitted for hauling purposes in firedamp collieries, while the electric form of tractor, having exposed leads for conducting the current, is mostly excluded as being too dangerous.



Internal-combustion Locomotive Used at Germania Mine

The Otto mining locomotive carries its own supply of fuel and water, and, on account of the small quantity that it consumes of each, can run for a long time with a moderate supply; the tanks, situated at the upper part of the locomotive, hold enough fuel for a run of from 12 to 16 hours. The consumption of fuel, reckoned on the net ton-mile, necessarily fluctuates a great deal, according to the state of the track, the size of the tractor and the mean load on the engine; under favorable conditions it amounts to about 0.21 lb. of gasoline per net ton-mile, increasing to about 0.28 lb. when the conditions are not favorable.

The accompanying halftone shows an Otto mineral locomotive running in the Germania mines. An 8-hp. locomotive of this type for underground work for 2-ft. gage has the following overall dimensions: Total length, 3 ft. 11 in.; width, 2 ft. 7½ in.; height, 4 ft. 7 in. The engine is an internal-combustion engine, working on the Otto cycle of the horizontal type, and especially adapted to locomotive work. The cylinder is 6¾ in. diameter by 9½-in. stroke. The engine runs at a constant speed of about 300 r.p.m., and transmits its power by means of machine-cut, cast-steel tooth and sprocket wheels, friction couplings, and chains to the axles.

The gearing is arranged so as to give the locomotive two speeds, i.e., four and eight miles per hour. At the lower speed the locomotive is capable of hauling a gross load of about 23 tons, and at the higher speed a load of about nine tons on the level, the tractive energy on the drawbar being 615 and 240 lb., respectively. The service weight of the locomotive is four tons. As fuel, crude or refined benzol, petrol, etc., may be used. The consumption when using benzol is about 0.6 lb. per horsepower-hour. The oil-tank capacity is about 11 gal., and it is large enough for a double shift of 16 hours. The consumption of cooling water is exceptionally small, being about 0.2 gal. per horsepower-hour.

The electric ignition, by means of a spark, takes place inside the cylinder only. Since any escape has to pass a number of filters, it is killed before it reaches the outer atmosphere, thus obviating danger of explosion. The method of traction which this locomotive employs presents points of favorable comparison with other methods. The initial outlay is not excessive, and the locomotive is self-contained, being independent of any central supply station.

It is obvious that such a method of traction, should it establish itself as reliable and efficient, would simplify greatly the problems involved in mining extensions. New tracks or galleries could be opened up in any direction, and the tractor not being confined to one place, would be available immediately for the work of hauling on a new track. A further obvious advantage is that should one tractor be under repair, it would not involve the entire suspension of the traction work of the mine, as necessarily results from the breakdown of a main hauling engine or a failure of current in the case of an electric drive.

*Engineer, P. O. Box 151, Brussels, Belgium.

The Steel Corporation in 1911

The report of the United States Steel Corporation for the calendar year 1911, covers the usual wide range which the great extent and variety of the interests of the company make necessary.

A large production with lower prices and reduced profits. Gross earnings of $615,148,140 and net of $104,305,466 enabled the Corporation to continue dividends of 7% on preferred and 5% on common stock.

Note—Abstract of annual report.

The Balance Sheet

The general balance sheet of the company, condensed as much as possible, is given in Table 1 herewith.

TABLE I. SUMMARY OF GENERAL BALANCE SHEET

Common stock	$508,302,500
Preferred stock	360,281,100
Steel Corporation bonds	459,623,500
Subsidiary companies' bonds and stocks	162,627,502
Current accounts and liabilities	51,636,059
Reserve funds	23,126,677
Appropriations for new property	40,000,000
Undivided surplus	133,691,195
Total liabilities	$1,739,288,533
Property accounts	$1,460,303,983
Deferred charges	9,208,582
Investments	2,383,885
Sinking and reserve fund assets	13,149,161
Cash and current assets	254,242,922
Total assets	$1,739,288,533

The bonded debt includes $459,623,500 direct obligations of the Steel Corporation, and $160,877,876 bonds of subsidiary companies, of which $78,903,000 are guaranteed. There are $58,908,500 bonds held in the several sinking funds. During 1911, a total of $33,141,000 bonds of subsidiary companies were issued and sold, in payment for purchases of property, payment for construction and payment for maturing issues. Deducting bonds and mortgages paid off, there was a net increase of $23,917,641 in the bonded debt during the year. The total inventory valuations at the close of 1911, excluding inter-company sales and profits, were $153,483,589, an increase of $10,650,204 during the year.

The Income Account

The general income account, condensed and freed from duplications as much as possible, is given in Table II, herewith:

The gross receipts for 1911 were less than those of 1910 by $88,812,585. The operating expenses included $488,134,474 for manufacturing and producing cost and operating expenses, including ordinary maintenance and repairs; $16,554,153 for administrative, selling and general expenses; $13,000,481 for taxes and current interest.

Adding to the surplus of the year net receipts on account of depreciation and replacement funds; receipts from bonds of subsidiary companies sold, and amounts realized on investments, a fund amounting to $54,182,912 was formed. From this, payments were made as follows: Additional property, construction and mine developments, $49,430,861; obligations paid off, $4,016,658; advances on account of mining royalties, $876,877; miscellaneous, $278,685; total, $54,603,081. This total was $420,169 in excess of the credits, the additional sum being provided from working assets.

TABLE II. GENERAL INCOME ACCOUNT

Gross sales and earnings	$615,148,840
Rentals and miscellaneous	957,651
Interest on investments	2,804,939
Profits on subsidiary companies' accounts	11,120,839
Total credits	$630,032,289
Operating charges	$517,689,108
Interest, subsidiary companies	8,037,695
Total charges	$525,726,803
Net earnings for the year	$104,305,466
Adjustment of accounts	81,780
Total net receipts	$104,387,246
Depreciation charges	$19,839,099
Interest and sinking funds	29,247,850
Dividends, pref. stock, 7%	25,219,677
Total charges	$74,306,626
Balance, surplus	$30,080,620
Dividends on common stock, 5%	25,415,125
Undivided surplus	$4,665,495

Production and Shipments

Table III herewith, shows the production for the year, compared with that for 1910. This table gives the total tonnages of finished products for sale.

Table IV gives the shipments of finished products to domestic and foreign purchasers. Foreign or export business was 18.2% of the total shipments of finished steel

No data as to manufacturing costs are given. A calculation, based on the tonnage of finished steel and excluding cement and other byproducts, shows that the gross receipts were $64.92 per ton; the net earnings, $11.07; and the dividends paid, $5.33 per ton. These figures, however, only constitute a general and rough approximation.

Employees and Wages

Table V, herewith, gives the number of employees and the wages paid for two years.

In continuance of the plan observed in previous years, beginning with 1903, the employees of the Corporation and the subsidiary companies were, in January, 1912, offered the privilege of subscribing for preferred or common stock. The subscription price was fixed at $110 per share for preferred and $65 for common stock.

The allowances for special compensation or bonus to be paid subscribers who retain their stock were fixed at $5 per share per year for the preferred and $3.50 per share annually for the common stock. The conditions attached to the offer and subscription, aside from the features of subscription price and the amount of special compensation or bonus to be paid, were substantially the same as those under which stock has been offered to employees in each of the previous nine years. Subscriptions were received from 36,946 employees for an ag-

TABLE III. PRODUCTION OF WORKS

Products	1910 Tons	1911 Tons
Iron ore mined:		
In Lake Superior Region:		
Marquette Range	830,094	560,685
Menominee Range	1,384,465	1,105,044
Gogebic Range	1,801,480	1,264,734
Vermilion Range	1,338,110	1,182,075
Mesabi Range	17,910,366	14,581,530
In Southern region:		
Tennessee C., I. & R.R. Co	1,981,301	1,239,563
Total	25,245,816	19,933,631
Coke made:		
In bee-hive ovens	11,641,105	9,491,206
In byproduct ovens	2,008,473	2,629,006
Total	13,649,578	12,120,212
Coal mined, not used for coke	4,850,111	5,290,671
Limestone quarried	5,005,087	4,835,703
Blast furnace production:		
Pig iron	11,645,510	10,593,726
Spiegel	102,260	66,435
Ferromanganese and silicon	83,628	84,736
Total	11,831,398	10,744,897
Steel ingots:		
Bessemer	5,796,223	5,055,696
Openhearth	8,383,146	7,697,674
Total	14,179,369	12,753,370
Rolled and other finished steel products for sale:		
Steel rails	2,118,473	1,568,028
Blooms, billets, sheet and tinplate bars	682,364	874,474
Plates	929,020	630,512
Heavy structural shapes	656,797	547,186
Merchant steel	1,527,506	1,221,606
Tubing and pipe	868,550	863,670
Wire rods	133,722	118,302
Wire and products	1,490,318	1,613,754
Sheets and tinplate	1,082,787	1,079,046
Finished structural	589,228	518,399
Splice bars and rail joints	235,998	160,855
Spikes, bolts, nuts and rivets	71,326	60,386
Axles	101,066	52,046
Steel car wheels	98,105	36,652
Sundry steel and iron products	148,735	131,332
Total	10,733,995	9,476,248
Spelter	26,777	28,333
Sulphate of iron	33,684	28,381
Universal portland cement, bbl.	7,001,500	7,737,500

gregate of 30,619 shares of preferred and 30,735 shares of common stock.

Iron Ore and Fuel

The summary of iron ore property shows that the Corporation owns, leases or otherwise controls 78 mines in the Lake Superior region. In the Southern district it has 21 mines. The acreage and estimated contents are not given.

In Pennsylvania, West Virginia, Ohio, Indiana and Illinois it owes 230,501 acres of coal lands and 24,374 acres of surface. There are 31 coal plants not connected with coke plants; 78 coke plants with 23,947 bee hive and 1172 byproduct ovens. In the South it owns 343,129 acres, on which are 23 mines and 7 coking plants with 2974 beehive ovens; and one plant, with 280 byproduct ovens under construction.

The Carnegie Natural Gas Co. has in Pennsylvania and West Virginia extensive natural gas territory, either owning or having under lease about 188,829 acres and owning 629 miles of pipe lines, six pumping stations and 426 active wells. Extensive natural gas territory and pipe lines are controlled and owned by the American Sheet & Tin Plate Co. in Pennsylvania and by the National Tube Co. in Ohio. The former company has under lease about 32,368 acres of gas territory, and owns one large and four smaller pumping stations and 161 active wells. The National Tube Co. has under lease about 10,823 acres of gas territory and five developed wells.

Transportation

The Corporation owns or controls railroad properties having 1363 miles main line, 737 miles branches and spurs, 403 miles second track and 987 miles sidings. The equipment of these lines includes 1193 locomotives and 46,334 cars.

Floating equipment owned includes 81 steamers, 22 barges, 1 scow and 2 tugs on the Great Lakes; 2 steamers and 108 barges on the Ohio River. There are 9 ore docks owned at Lake Superior ports and 8 at Lake Erie ports.

General Remarks

The material slackening in the domestic demand for the products of the subsidiary companies, which became apparent in the fall of 1910, continued in a marked degree until the early part of 1911 and to a greater or less extent until the closing weeks of that year. In November, 1911, a substantial buying movement developed, the subsidiary companies' unfilled orders on hand rising to a total of 5,084,761 tons at Dec. 31, 1911. This improvement in business has maintained fairly well since the first of the year and to the date of writing this report. At Feb. 29, 1912, the unfilled order tonnage equaled 5,454,200 tons. In May, 1911, a sharp break occurred in selling prices of nearly all steel products, and prices continued to decline, gradually reaching in the latter part of the year the lowest figures, in respect of most of the commodities, which have been realized in 14 years.

In order to insure to the subsidiary companies operating blast furnaces in the Pittsburg, Valley and Cleveland districts, a supply of coke for a period of years more nearly equal to that which the large investment in furnaces and dependent mills requires, there were acquired from the Pittsburg Coal Co. and the Monongahela River Consolidated Coal & Coke Co. on July 1, 1911, by the H. C. Frick Coke Co., a subsidiary of the corporation, the following coking coal properties: 15,943 acres of unmined coal and 1408 acres of surface situated in Fayette, Greene and Washington counties, Pennsylvania. On this property there are three developed and operating coal mines, three coking coal plants comprising 986 beehive ovens, necessary tenements, equipment, tools, etc., for complete operation of the mines and ovens. A large part of the coal acreage acquired is located on the Monongahela River. A portion of the acquired property also lies immediately in front of the extensive Mingo tract of coal (owned by Carnegie Steel Co.) in Washington County, thus providing a practical means for a large part of the Mingo property to be worked to the river.

TABLE IV. SHIPMENTS OF PRODUCTS

	Domestic	Export	Total
Finished steel	7,740,897	1,719,272	9,460,169
Pig, spiegel, etc.	399,935	26,728	426,663
Iron ore, coal and coke	1,587,322	.....	1,587,322
Byproducts	63,206	492	63,698
Total	9,791,360	1,746,492	11,537,852
Cement, bbl.	7,586,758	110,364	7,697,122

TABLE V. EMPLOYEES AND WAGES

Plants:	1910	1911	Changes
Manufacturing	154,563	140,118	D. 14,445
Coal and coke	23,528	21,723	D. 1,805
Iron ore	16,956	14,445	D. 2,511
Transportation	20,758	17,963	D. 2,795
Miscellaneous	2,630	2,639	I. 9
Total	218,435	196,888	D. 21,547
Total annual wages:	$174,955,139	$161,419,031	D. $13,536,108
Av. yearly wage:	$800.95	$819.80	I. $18.85

The Gary Plant

At the close of the year nearly all of the manufacturing plant construction heretofore authorized for the Gary, Ind., district had been completed. At the steel plant of the Indiana Steel Co. the sheet bar mill was completed June 29, 1911; the two 12-in. and the 10-in. merchant bar mills about Sept. 1, 1911; the 60-in. plate mill on Nov. 4, 1911. The first battery of the byproduct coke plant, consisting of 70 ovens, went into operation on April 12, and 4 additional batteries at various later dates in 1911. The third unit of openhearth furnaces, consisting of 14 furnaces of 65 tons capacity each, was placed in operation in February, 1912. An addition to the electric power station, consisting of six generators of 3000 kw. each, driven by gas engines, was completed during the year. The several units of the sheet plant of the American Sheet & Tin Plate Co. and of the bridge and structural plant of the American Bridge Co., both at Gary, were completed and commenced operations at various dates during the year.

The output of the Gary steel plant of the Indiana Steel Co. during 1911 was as follows: 707,273 tons of pig iron, 1,036,545 tons of openhearth steel ingots, 281,980 tons of openhearth steel rails and 469,360 tons of various other rolled-steel products. The byproduct coke plant produced 811,804 tons of coke. The production of the sheet plant was 24,556 tons of black and galvanized sheets, and at the bridge plant there were produced 27,371 tons of fabricated steel work.

The actual amount expended to Dec. 31, 1911, at Gary by the several subsidiary companies for acquirement of real estate, development and construction, was $78,258,509 in all.

Other New Property

There was purchased in May, 1911, for warehouse purposes the property of the Risdon Iron & Locomotive Works in San Francisco, Calif. The plant had previously been operated in the ship and engine building and repairing business, and had for a long time been offered for sale. The property consists of about 20 acres of land, with considerable water front, is well located and has on it several buildings especially adapted for the storage and warehousing of steel products. It is believed that by carrying on the Pacific Coast large and varied stocks of the products of the subsidiary companies their distribution will be materially expanded. Substantial progress was made during the year on the construction of the new steel plant at Duluth, Min. The expenditures for the plant and the terminal railroads serving the same amounted for the year to $1,437,518. An additional outlay of $1,037,969 was made in payment for coal property in Illinois and Indiana, the purchase of which had been contracted for in previous year, and for the development of the properties.

Pension Fund

There was set aside from the accumulated undivided surplus the sum of $663,018 for permanent pension fund, reference to which was made in last year's report. Of the foregoing amount $163,018 was paid over in cash to the board of trustees of the United States Steel & Carnegie Pension Fund for use by the board as cash working fund. A like amount for similar purpose was also contributed by the Carnegie Relief Fund. The balance of the appropriation first mentioned, together with the $1,000,000 set aside in previous years for pension purposes, is carried to credit of pension fund in general balance sheet. During the year the Corporation also paid over to the board of

trustees $156,301, which was charged to current operations. This amount together with the $200,000 of income received by the trustees from Carnegie Relief Fund (being the income on the $4,000,000 fund created by Mr. Carnegie), and making a total of $356,302, was disbursed by the trustees during the year for pension and relief purposes. At the close of the year there were 1606 ex-employees on the pension rolls.

Hill Ore Leases

In the annual report for 1906 reference was made to the arrangement which had been consummated for a lease of the so called Great Northern Ry. ore properties by the Great Western Mining Co., a subsidiary company of this corporation. In accordance with an option reserved to the lessee to cancel the lease on Jan. 1, 1915, the Great Western Mining Co. on Oct. 26, 1911, formally notified the lessors that the company elected to cancel the lease. To Dec. 31, 1911, there had been mined and shipped under this lease 7,832,137 gross tons of ore; and royalties had been prepaid on account of minimum tonnages for years prior to 1911, covering an additional 2,892,183 tons. It is expected this prepaid tonnage, as well as the minimums called for by the lease for years 1912, 1913 and 1914, namely, 15,750,000 tons, will be mined and shipped prior to 1915, thus making an aggregate of 26,474,320 tons of ore which it is expected will be shipped under the lease prior to its relinquishment on Jan. 1, 1915. This total tonnage is equal to about one year's ore requirements of the blast furnaces of the subsidiary companies (exclusive of those of the Tennessee company) on the basis of the furnaces operating normally full throughout the year.

The Government Suit

On Oct. 26, 1911, the United States government filed a petition in the Circuit Court of the United States for the district of New Jersey against the corporation and a number of its subsidiary companies, alleging that the corporation and its codefendants are in violation of the Act of Congress of July 2, 1890, and asking that they be adjudged to be illegal and that they be dissolved. On Oct. 27, 1911, an official statement with reference to this proceeding was issued on behalf of the Corporation by its chairman which has heretofore been published. The answer of the corporation and codefendants was filed with the Court on Feb. 1, 1912, and a summary of it is sent to each stockholder with the annual report.

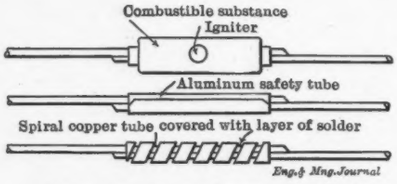
United States Potash Works

A description of a potash-producing plant in the United States is given in a recent press bulletin of the U. S. Geological Survey. This works is in southern California about 30 miles north of San Diego, where it was stated that operations in the commercial extraction of potash from kelp or seaweed would begin about Mar. 1. The plant is owned by the Coronado Chemical Co., which has been working on the kelp-potash problem for several years. It consists of four furnaces capable of treating 6000 lb. of dried kelp per 24 hours, and additional furnaces are under construction with a proposed total capacity for treating 36,000 lb. of dried kelp per day.

A New Tube Joint for Electric Wires

A novel tube-joint for uniting electric wires has recently been invented and patenter by Carl Egnér and Seth Ljungqvist, two Swedish engineers. No blowpipe, lamp or solder-melting furnace is required to make a finished joint.

For outside wires the tube consists of a copper band wound spirally, so that it is oval in cross-section. This tube is tinned and dipped in resin. Over this tube is placed one or two wraps of solder in plate form, the solder being an alloy of 63 parts tin and 37 parts lead. A jacket of aluminum incloses the copper tube and covering of solder, and over the aluminum is a covering of combustible matter similar in composition to the substance of which storm matches are made. The combustible covering is provided with



Tube Joint for Outside Wires

an ignitible substance like that used for safety matches.

The tubes are made in sizes corresponding to all standard diameters of wire. To make the joint, the ends of the wire are cleaned with emery paper, dipped in soldering fluid and inserted side by side in the tube, the ends projecting in opposite directions. The combustible material is then ignited by rubbing the coated side of the box in which the tubes are packed on the ignitible part of the outer coating. The heat arising from the burning combustible matter melts the solder so that it runs and fills the space between the wires and the inner copper tube. The aluminum cover, which prevents gases from mixing with the molten solder, remains loose on the joint when the solder is cold. It is removed and discarded. This tube also diffuses the heat over all the length of the joint and prevents the molten solder from running out.

For joining inside wires, a tube of cylindrical section is used, which is provided with an opening lengthwise and perforations to allow the solder to run inside the tube. The ends of the wires are cleaned and inserted from opposite sides, so as to meet in the middle of the tube. The joint is then made in the same manner as the outside wires.

It is claimed that tests made at the Swedish telegraph testing office show that the strength of the joint is only 0.6% less than the tensile strength of the wire, and that the heat does not materially affect the metal even in the case of hard-drawn copper and iron wires. The tubes and plates are so proportioned that there is little loss in conductivity. These tubes are being manufactured in Sweden, and A. E. Sylven, 29 Broadway, New York, is the sales agent in the United States.

Retreatment of Rand Tailings

Johannesburg Correspondence

It has long been recognized that the older tailing dumps along the reef offer some prospect of successful retreatment for their gold contents. The Stark leaching process was a success in certain dumps, which were situated so that the solution pumped over them *in situ* could be collected without undue leakage loss, and I am somewhat surprised that no attempt appears to have been made elsewhere to carry out the process. It will be remembered that the gold was precipitated on scrap iron.

It is known that the gold contents of the older sand dumps range in value from 3 to 6s. per ton, and that the bulk of the gold is contained in the coarser particles of quartz and pyrite, which require regrinding to extract their contents by cyanidation or amalgamation. Hence the failure of attempts to concentrate these dumps on vanners.

Prof. Stanley, of the South Africa School of Mines, came to the conclusion that any successful scheme must include hydraulicking or other cheap means of transferring the sands to treatment, some scheme of hydraulic classification with regrinding of spigot products and their subsequent treatment by cyanide. He has invented and patented a splitzlutte, having vibrating screens in the upper current, which combines hydraulic classification with screen sizing.

This machine, on small-scale operations, separates 90% of the valuable portions of the sands rapidly and efficiently at a cost of 6d. per ton treated; regrinding is estimated to cost in tube mills 7½d. per ton treated, with cyaniding slimes and sands from reground concentrates to cost 1s. 3d. per ton; a total cost of 2s. per ton on the total tonnage treated. Where the sands must be removed for stope-filling purposes, a saving would be effected. It is estimated from the results of the trial plant run at the Robinson mine that 75 to 80% of the total precious-metal contents of 3 to 6s. per ton will thus be recovered, which leaves a large margin of profit. A company, called "Sands Limited," has been formed to exploit the process in Africa and elsewhere.

Mining and Metallurgical Patents

A Classified List of New Inventions

A copy of the specifications of any of these patents issued by the United States Patent Office will be mailed by The Engineering and Mining Journal upon the receipt of 25 cents. In ordering specifications, correspondents are requested to give the number, name of inventor and date of issue.

COPPER

FUSING AND PURIFYING—Process of Fusing and Purifying Copper. Walter S. Rockey and Hilliary Eldridge, New York, N. Y., assignors to Metallurgical Research Co. (U. S. No. 1,018,681; Feb. 27, 1912.)

LEACHING—Process of Treating Copper Ores or Copper-Ore-Mill Tailings. John W. Bennie, Clifton, Ariz. (U. S. No. 1,019,708; Mar. 5, 1912.)

ROASTING—An Improved Method of Chlorinating Roasting of Ores. Helsingsborgs Kopparverks Aktiebolag, Helsingborg, Sweden. (Brit. No. 11,515 of 1911.)

SCRAP—Process of Remelting and Refining Old or Scrap Copper Alloy. Walter S. Rockey and Hilliary Eldridge, New York, N. Y., assignors to Metallurgical Research Co. (U. S. No. 1,019,524, Mar. 5, 1912.)

GOLD AND SILVER

AMALGAMATOR. James G. Scott, Morgantown, Ind. (U. S. No. 1,018,448; Feb. 27, 1912.)

BLACK-SAND-SEPARATING MACHINE. Jacob M. Burch, Wallace, Idaho, assignor of one-fourth to John Lafors, Wallace, Idaho. (U. S. No. 1,017,506; Feb. 13, 1912.)

CONCENTRATOR — Centrifugal Ore and Slime Concentrator. Christoffer A. Christensen, Portland, Ore. (U. S. No. 1,018,898; Feb. 27, 1912.)

CYANIDING—Method and Apparatus for the Precipitation of Gold and Silver from Cyanide Solutions. Daniel Bosqui, Gold Road, Ariz., assignor, by mesne assignments, to Merrill Metallurgical Co., San Francisco, Cal. (U. S. No. 1,018,604; Feb. 27, 1912.)

CYANIDING—Process for the Precipitation of Precious Metals from Cyanide Solutions. James Millar Neil, Toronto, Ontario, Canada, assignor to Alexander M. Hay, Toronto, Canada. (U. S. No. 1,018,438; Feb. 27, 1912.)

FILTER. Charles Edward Singer, Parral, Mexico. (U. S. No. 1,017,476; Feb. 13, 1912.)

FILTER PRESSES—Improvements in Filter Presses for Use in Connection with Hydrometallurgical Processes. C. W. Merrill, Berkeley, Cal. (Brit. No. 2802 of 1911.)

SETTLING TANK. Alexander John Arbuckle, Johannesburg, Transvaal. (U. S. No. 1,020,013; Mar. 12, 1912.)

TUBE-MILL LINER—Feed and Discharge End-Liner for Tube-Mills. Henry C. Holthoff, Mexico, Mexico, assignor to Allis-Chalmers Co., Milwaukee, Wis. (U. S. No. 1,018,320; Feb. 20, 1912.)

IRON AND STEEL

ELECTRIC FURNACES—Improvements Relating to Electric Furnaces. Rochling'sche Eisen- und Stahlwerke, G. m. b. H. & W. Rodenhauser, Volklingen-on-Saar, Germany. (Brit. No. 10,231 of 1911.)

HOT-BLAST STOVE. Walther Mathesius, Charlottenburg, Germany. (U. S. No. 1,018,331; Feb. 20, 1912.)

MANGANESE STEEL — Heat Treatment of Manganese Steel. Winfield S. Potter, New York, N. Y. (U. S. No. 1,017,907; Feb. 20, 1912.)

MANGANESE STEEL — Heat Treatment and Rolling of Manganese Steel. Winfield S. Potter, New York, N. Y. (U. S. No. 1,018,000; Feb. 20, 1912.)

MANGANESE STEEL — Producing Rolled Shapes of Manganese Steel. Winfield S. Potter, New York, N. Y. (U. S. No. 1,017,904; Feb. 20, 1912.)

MANUFACTURE—Apparatus for the Manufacture of Steel. William R. Walker and James H. Gray, New York, N. Y. (U. S. No. 1,018,644; Feb. 27, 1912.)

LEAD, ZINC AND OTHER METALS

ALUMINUM — Method of Treating Aluminum. Auguste J. Rossi, Niagara Falls, N. Y., assignor to The Titanium Alloy Manufacturing Co., New York, N. Y. (U. S. No. 1,019,531; Mar. 5, 1912.)

ANTIMONY—A Process for the Electrolytic Production of Metallic Antimony from Antimony Ores or Compounds. R. C. V. Whitfield, Chambers, Eng. (Brit. No. 9968 of 1911.)

BORON AND ZIRCONIUM—Improved Method of an Apparatus for Producing Boron and Zirconium. E. Weintraub, Lynn, Mass. (Brit. No. 25,033 of 1910.)

LEAD—Method of Manufacturing Arsenate of Lead. E. O. Barstow, Midland, Mich., assignor to Dow Chemical Co. (U. S. No. 1,014,742; Jan. 16, 1912.)

TIN—Process of Treating Tin-Bearing Material. Josef Weber, Essen-on-the-Ruhr, Germany, assignor to Th. Goldschmidt, Essen-on-the-Ruhr, Germany. (U. S. No. 1,018,734; Feb. 27, 1912.)

TITANIUM—Process of Obtaining Titanic Oxide. George Weintraub, Lynn, Mass., assignor to General Electric Co. (U. S. No. 1,014,793; Jan. 16, 1912.)

TITANIUM ALLOY—Process for Producing the Alloy of Titanium with Lead. Auguste J. Rossi, Niagara Falls, N. Y., assignor to The Titanium Alloy Manufacturing Co., New York, N. Y. (U. S. No. 1,019,529; Mar. 5, 1912.)

TITANIUM ALLOYS—Process for Producing Alloys of Titanium with Ferrometal. Auguste J. Rossi, Niagara Falls, N. Y., assignor to The Titanium Alloy Manufacturing Co., New York, N. Y. (U. S. No. 1,019,528; Mar. 5, 1912.)

VANADIUM—Process for Recovery of Vanadium. Byramji D. Saklatwalla, Bridgeville, Penn., assignor to The American Vanadium Co., Pittsburg, Penn. (U. S. Nos. 1,020,224 and 1,020,312; Mar. 12, 1912.)

ZINC—Improvements in Recuperative Zinc Furnaces. A. Folliet Mieusset, Liege, Belgium. (Brit. No. 2250 of 1911.)

MINING—GENERAL

BLASTING—Apparatus for Reducing or Neutralizing the Noxious Fumes Resulting from the Combustion of Nitroglycerin Explosives. Edward Macaulay, Paignton, England. (U. S. No. 1,019,502; Mar. 5, 1912.)

DRILL—Rock-Core Drill. William R. Wallace, Houghton, Mich. (U. S. No. 1,019,206; Mar. 5, 1912.)

DRILL—Rock-Drill. Thomas Francis Carroll, Mount Carmel, Penn. (U. S. No. 1,015,780; Jan. 30, 1912.)

DRILLS—Improvements in Machines for Forging and Sharpening Rock Drills. J. G. Leyner, New York. (Brit. No. 1923 of 1911.)

DRILLS — Mounting for Air-Feed Drills. William Prellwitz, Easton, Penn., assignor to Ingersoll-Rand Co., New York, N. Y. (U. S. No. 1,019,361; Mar. 5, 1912.)

FLUME GATE. Wilson Polk Harlan, Holtville, Calif. (U. S. No. 1,018,662; Feb. 27, 1912.)

HOISTING—Gear for the Prevention of Overwinding. John Shaw, Kirby Moorside, North Riding, England; John Reginald Shaw, Elmsall Lodge, Pontefract, England, administrator of said John Shaw, deceased. (U. S. No. 1,017,600; Feb. 13, 1912.)

LAMP—Miner's Lamp. William E. Pinkney, Scarbro, W. Va. (U. S. No. 1,016,645; Feb. 6, 1912.)

MINE ALARM INSTRUMENT. Henry White Lee and George Henry Weedman, Mount Morgan, Queensland, Australia. (U. S. No. 1,018,328; Feb. 20, 1912.)

SAFETY APPARATUS for Miners' Trucks. Valentin Stasch, Friedenshütte, Germany, assignor of one-half to The Firm of Grüflich Schaffgotsch'sche Werke, G. M. B. H., Beuthen, Germany. (U. S. No. 1,019,281; Mar. 5, 1912.)

SAFETY STOP FOR MINE CARS. Henry H. Herbold, Thayer, and Charles Hegner, Cainesville, Mo.; said Herbold assignor to said Hegner. (U. S. No. 1,019,249; Mar. 5, 1912.)

SHAFT SINKING—Method for Sinking a Mine Shaft in a Water-Bearing Soil which is Weak or Porous. J. Gevers, Antwerp, Belgium. (Brit. No. 21,788 of 1911.)

WEIGHING MACHINE — Automatic Weighing and Recording Mining-Car Scale. George Goetz, Chicago, Ill., assignor to Streeter-Amet Weighing & Recording Co., Chicago, Ill. (U. S. No. 1,017,747; Feb. 20, 1912.)

ORE DRESSING—GENERAL

CONCENTRATION—Improvements in or Relating to Ore Concentration. E. H. Nutter, London, Eng. (Brit. No. 2383 of 1911.)

CONCENTRATOR—Ore Concentrator. Emil Deister, Fort Wayne, Ind., assignor to The Deister Concentrator Co. (U. S. No. 1,019,884; Mar. 12, 1912.)

CONCENTRATORS—Improvements in Ore Concentrators. Emil Deister, Fort Wayne, Ind. (Brit. No. 22,892 of 1911.)

CRUSHER—Ore Crusher. Ezra A. Mathers, Philadelphia, Penn., assignor of one-half to Daniel W. Harner, Philadelphia, Penn. (U. S. No. 1,017,780; Feb. 20, 1912.)

CRUSHING — Compound Ball Mill. Richard Beneke, Bromberg, Germany, assignor to Limited Company Herm. Lönnert, Aktiengesellschaft, Bromberg, Germany. (U. S. No. 1,017,946; Feb. 20, 1912.)

CRUSHING—Improvements in Crushing Mills. T. J. Sturtevant, Boston, Mass. (Brit. No. 23,394 of 1911.)

CRUSHING—Stone-Crushing Machine. Edgar B. Symons, Fort Wayne, Ind., assignor, by mesne assignments, to Smith Post Co., Milwaukee, Wis. (U. S. No. 1,019,997, Mar. 12, 1912.)

ELECTROSTATIC SEPARATOR. Henry M. Sutton, Walter L. Steele and Edwin G. Steele, Dallas, Tex. (U. S. No. 1,017,701; Feb. 20, 1912.)

PULP DIVIDER—Apparatus for Subdividing Streams of Pulp and Other Liquids. Hans Charles Behr and Charles Friedrich Eduard Oscar Schmitt, Johannesburg, Transvaal. (U. S. No. 1,020,251, Mar. 12, 1912.)

SEPARATION — Improved Mechanico-Chemical Process for the Separation of Ores. Campagne d'Entreprises de Lavage de Minerais, Paris, France. (Brit. No. 8154 of 1911.)

WASHING ORES—Process and Apparatus for Washing Ores Containing Sulphides. O. Malkemus, Benolpe, and Carl Pletsch, Attendorn, Germany. (Brit. No. 15,292 of 1911.)

METALLURGY—GENERAL

ELECTROLYTIC APPARATUS FOR ASSAYING. Herbert E. T. Haultain, Toronto, Ontario, Canada. (U. S. No. 1,018,901; Feb. 27, 1912.)

METAL OXIDES—Process of Making Metal Oxides. Hans Foersterling, New York, N. Y. (U. S. No. 1,019,004; Feb. 27, 1912.)

REDUCTION — Improvement in the Method of and Apparatus for Reducing Ores of Volatile Metals. H. H. Hughes, Springfield, Mo. Brit. No. 570 of 1911.)

ROASTING—An Improvement in Processes for Roasting Sulphide Ores. C. W. Renwick, Isabella, Tenn. (Brit. No. 1267 of 1911.)

ROASTING KILN—Recuperative Roasting Kiln. John Zellweger, St. Louis, Mo. (U. S. No. 1,017,839; Feb. 20, 1912.)

SCRAP METAL—Process of Melting Scrap Metal. Albert E. Greene, Chicago, Ill. (U. S. No. 1,018,418; Feb. 27, 1912.)

PERSONAL

Mining and metallurgical engineers are invited to keep THE ENGINEERING AND MINING JOURNAL informed of their movements and appointments.

F. F. Sharpless has gone to Missouri on professional business.

B. R. Bates is now with El Rayo Mining & Development Co. at Santa Barbara, Chihuahua, Mexico.

Charles Janin and Ross Browne Hoffmann were in New York this week on their way to London.

H. Kenyon Burch, of Los Angeles, Calif., was recently in Globe, Ari., on professional business.

Arthur L. Flagg, late of Durango, Mexico., is now with Glenville A. Collins, Spokane, Wash., as associate engineer.

E. Jacobs, of Victoria, B. C., secretary of the Western Branch of the Canadian Mining Institute, has been visiting New York.

Pope Yeatman will go to Chile about the middle of April, expecting to be absent from New York for about three months.

H. W. Hardinge lately returned to New York from mining investigations in Alabama, but is now in the West on professional work.

Morris Levit, salesman for many years for the Joshua Hendy Iron Works, San Francisco, is now assistant manager of the company.

James G. Ross, consulting mining engineer of the Milton Hersey Co., Ltd., Montreal, is in British Columbia on professional business.

E. E. Hedges, of Boston, is at the Laurentian mine, Manitou district, Ontario, of which he is the principal owner, directing operations.

J. F. Erdletz left New York last week on his way to Siberia. His address is care Russian Mining Corporation, Salisbury House, London.

Robert R. Hedley, of Vancouver, B. C., paid a short visit to New York about the middle of March. On Mar. 17, he left Toronto on his return journey to British Columbia.

J. C. Murray, of Toronto, Ontario, editor of the *Canadian Mining Journal*, was in New York, Mar. 22, on his way to Bermuda, where he purposed spending a vacation of two or three weeks.

R. H. Flaherty, late of the United States Steel Corporation and now head of the mining department of Mackenzie, Mann & Co., is investigating the iron-ore deposits of British Columbia, in connection with the projected establishment of a large steel plant, at Port Mann.

Franklin Guiterman, general manager of the Colorado department of the American Smelting & Refining Co., has been transferred to the New York office of that company of which he is a director and member of the executive committee. Mr. Guiterman will remain in general charge of the Colorado department, and besides other new duties will be vice-president and general manager of the New Rivers Collieries Company.

OBITUARY

Bert Reed Hicks is reported by cable to have been killed by bandits while on an exploring expedition up the Yangtse-Kiang River in China. He graduated from the Michigan College of Mines in 1909, and was soon after appointed professor of mining engineering in the Imperial College at Ching-tu, Szechuan, China.

Frederick W. McKee died at Pittsburg, Mar. 22, aged 54 years. He was born at Pittsburg and lived there all his life. Of late years he had given his attention to developing a large property which he owned in Winfield township, Butler County. At the time of his death he was treasurer of the Winfield Mineral Co.; treasurer of the Winfield Sand Co.; president and general manager of the Winfield R.R., and a director in the Pennsylvania Clay Products Co. He left a widow and four children.

W. Williams, for many years manager of the Tilt Cove Copper mine in Newfoundland, for the Cape Copper Co., of London, met with a fatal accident at Tilt Cove on March 13. He was dining at home with his wife and family when the snow crushed the house down and all the occupants were buried beneath the ruins and a large pack of snow. A number of miners spent several hours in searching for the buried persons and succeeded in reaching all of them. It was found that Mr. Williams and his son aged 13 years, had been killed instantly and one of the servants was dangerously burned by being pinned against the kitchen stove. She is not expected to survive; but the others are not seriously injured. Mr. Williams was very successful as general manager of the Tilt Cove mine and was popular with the miners. He was a native of England and had a varied experience in mining in England and Wales, in addition to Newfoundland.

Ralph Stockman Tarr, of the Department of Physical Geography at Cornell University, one of the best known geographers in the United States and an authority on glaciers and earthquakes, died suddenly at his home on the Cornell University Campus, Ithaca, N. Y., Mar. 21. Professor Tarr once led a Cornell expedition to Greenland, and he spent several summers in Alaska at the head of the expedition for the United States Geological Survey. In recent years he spent his summers in Alaska studying the glacial region for the National Geographic Society. Professor Tarr was born in Gloucester, Mass., in 1864. He was graduated from the Lawrence Scientific School, in 1891. He was assistant United States fish commissioner, in 1882-83, when he was connected with the Smithsonian Institution. He was assistant geologist of the Texas Geological Survey in 1888 and 1891. He was assistant in geology at Harvard, 1890-91, and was professor of dynamic geology and physical geography, 1897-1906. He was special field assistant of the United States Geological Survey since 1903. He was a member of the Geological Society of America, the Geological Society of Washington, the National Geographical Society, and the Association of American Geographers. He was corresponding member of the Geological Society of London. In addition to several text books, Professor Tarr compiled a "Physical Geography of New York State," and wrote monographs on geographical and geological topics.

Charles T. Harvey, who built the first canal at Sault Ste. Marie, died at the home of his son in New York City on March 13, at the advanced age of 83 years. Mr. Harvey's life was full of achievements which added greatly to the wealth and convenience of the world, but very little to his own fortune. He was born in 1829. His first employment was with E. & T. Fairbanks & Co., scale manufacturers of St. Johnsbury, Vt., in charge of establishing agencies for their weighing machines in the large western cities. While engaged in this pursuit he was stricken with typhoid fever and upon his convalescence his employers sent him into the Upper Peninsula of Michigan to recuperate. Just at that time Congress had authorized a grant of 750,000 acres of land to anyone that would build a canal around the rapids of St. Mary's river at the Sault. His mind was intensely practical and he saw at once the possibilities of wealth in the situation. He interested his employers in the undertaking and through their efforts a company was formed to build the canal. Harvey, though scarcely 24 years old at the time, was placed in charge of construction and prosecuted this work with wonderful vigor. Despite all obstacles the canal was finished and opened to commerce within two years. This was a considerable achievement when it must be borne in mind that the nearest machine shop was several hundred miles away and the nearest telegraph station at Detroit, 450 miles south. As soon as the canal was finished and accepted, Harvey selected the lands in payment for the work, among them being the location upon which was afterward developed the Calumet & Hecla mine. He also engaged in pig-iron manufacture in the peninsula, though this venture was not especially profitable. Later he was engaged in several other engineering works of importance and was active until a few years ago.

Editorial Correspondence

From our Representatives at Important Mining Centers

San Francisco

Mar. 22—Reports have been in circulation for some time to the effect that some unusually rich ore has been found at the Melones mine in Calaveras County. It is stated that a large pocket of free-gold quartz has been disclosed with indications of its opening into a considerable orebody. The ore is said to be extraordinarily high grade, but confirmation of its exact or approximate grade is lacking. It is said to be not improbable that the pocket is on the old Morgan vein at Carson Hill, which is an adjoining claim, and which was a large producer of nugget gold in the early days. It is rumored that ore worth $150,000 has been taken from this pocket within the last few weeks. Press dispatches state that ore running $4000 per ton has been mined, but this is undoubtedly greatly exaggerated. Official information, however, indicates that a discovery of rich ore has been made, and from the same source it is learned that at present not enough work has been done to show the extent of this ore.

Denver

Mar. 22—The Cripple Creek district as a whole is quiet. The drainage tunnel is completed as far as present funds will allow, and the water in the deep shafts is receding steadily. Regarding the great bodies of rich ore at depth, which the local press was so full of a few weeks ago, when the deep levels were being unwatered, the real truth is, that allowing for the natural rises and depressions of the surface, the bulk of the production below 1000 ft. will be medium- and low-grade ores, from $15 down to $3. There will, of course, be some exceptions. More mills will be built this summer and more low-grade ore will be handled in the district.

The Portland mill will soon be handling 15,000 tons per month, and at present, attempts are being made to treat the concentrates chemically at the mill. The Blue Flag mill has been resuscitated, and operations started Mar. 5 on oxidized ores from the Blue Flag mine. This makes six mills now in operation at the mines: Stratton's Independence, Portland, Ajax, Wild Horse, Cavanagh and Blue Flag; a possible milling capacity of 35,000 tons per month. The winter has been unusually severe, but from now on, lessees will become more active, more old dumps will be turned over and milled, and more small properties will be opened to lease. Cripple Creek is expected to be an active camp this summer.

The deep drainage tunnel at Cripple Creek, otherwise known as the "Roosevelt bore," has been driven a distance of 16,857 ft., at a cost of $576,000. In the report of T. R. Countryman, tunnel engineer, to the directors of the company, the cost of pumping is given at $5000 per vertical ft., and as the tunnel has already lowered the water level 118 ft., the cost of pumping to get the water to this level would have been $590,000 or more than the tunnel cost; as it may be said that the tunnel has practically only commenced to do its work and has already paid for itself, the results of this great work are eminently satisfactory. The rate of subsidence is now about 15 ft. per month, and the total flow from the portal about 16,000 gal. per minute.

Butte

Mar. 20—It has long been realized that there are great possibilities in the Georgetown mining district, in Deer Lodge County, but for the lack of good transportation facilities it has never had an opportunity to be developed to the extent that its mineral resources warrant. The coming of the Butte, Anaconda & Pacific R.R. into the region will change all this, and, in anticipation, much activity is being manifested there. Many new properties are being opened and work resumed on old ones. Electricity for hoisting and other purposes can be furnished cheaply to the mines of that section, as there is a large amount of water power to be had in the adjacent country. At Flint Creek Falls, nearby, there is already a power plant of 2500 hp., which can be increased at any time, and the company owning the plant is ready to sell power to any consumer in Georgetown desiring it. The ore in this region has excellent fluxing properties, and this is one reason that the Anaconda company recently bought the Southern Cross mine, and is extending its railroad there; the ore can be used to great advantage at the smeltery as a flux to mix with the more refractory ores.

The Anaconda company has refused to reinstate a number of Socialist miners, who were discharged recently. Officials of the company are reported to have said that the men were discharged not because they were Socialists, but because they had openly instigated insubordination among the employees. No serious consequences are expected as a result of the strike vote to be taken soon by the union.

Salt Lake City

Mar. 21—The U. S. Assay Office in Salt Lake City, during January, handled 6858 oz. gold and 1355 oz. silver, having a total value of $126,237. During February, bullion containing 5334 oz. gold, and 2167 oz. silver, a total value of $100,352, was received. The business for 1911 amounted to approximately $1,300,000, an increase of about $149,000 over 1909, the largest year preceding. The office receives bullion from Utah and six of the surrounding states, and during the three years it has been established, has handled $3,501,000 worth of bullion, or an average of $1,167,000 per year.

A new road, the Thompson & Ballard R.R., is being planned to develop coal lands in Grand County. Surveys have been made and the total length between the terminals of Thompson and Ballard will be about five miles.

Snowslides occurring at Alta, Mar. 16, slightly damaged the power line of the Columbus Consolidated and carried away several buildings of the Flagstaff mine. No lives were lost. Numerous snowslides have occurred in both Big and Little Cottonwood during the winter, but the damage has been less than usual.

Wallace, Ida.

Mar. 20—The lower tunnel at the Caledonia mine is in 150 ft. farther than the calculations showed the vein should be, and the latter has not yet been cut. It is probable that either the dip of the vein has become flatter or the strike has changed appreciably. The raise from the lower tunnel has cut the vein but drifts 75 ft. west and 150 ft. east failed to open a commercial orebody. The vein is strong, however, and shows low-grade ore. This is not surprising as the Caledonia orebodies are all in pockets. In the west drift a fault was encountered which cut off the vein; the latter was again picked up by crosscutting 50 ft. This fault may be the cause of the present miscalculation of the vein's position. Should the ore in this mine fail to continue with depth, it will be the first time that such a thing has occurred here in a mine which has produced from the upper levels. With more prospecting the orebodies will probably be found and it would not be surprising if they should be found to be the best yet opened in the mine, as the depth now being attained is about the same as that at which the greatest orebodies in the Cœur d'Alene mines have been found.

Deadwood, S. D.

Mar. 21—The proposal to fix the price of ore assays for gold and silver, at $1 per sample, has been urged by Black Hills men, to be put into effect at the U. S. assay office here. It has received the sanction of the director of the mint, providing no additional help will be needed to handle the business, and it is believed that the new price will soon go into effect. This would probably increase the business of the assay office. The present price is $3 per sample, which is rather high for the ordinary prospector. Many men are anxious to get an assay certificate with the government seal affixed, but they have found that they could scarcely afford the cost. Congressman Martin, of South Dakota, has been instrumental in getting the matter before the director of the mint.

El Paso, Texas

Mar. 20—A number of the representatives of the American mining companies operating in Mexico have formally turned over the property and interests of their companies to the charge of the American consuls in the respective districts, acting under the suggestion in the recent proclamation of warning issued by President Taft. This is done particularly as a means of making a record in case of any future claims for adjustment which may arise.

Generally the operating companies are endeavoring to continue activities and they are encouraged in this by the authorities because of the economic necessity of the communities but it is becoming more difficult because of the trouble in getting supplies and powder. On Mar. 20 it was reported that 90,000 lb. of dynamite, consigned to commercial organizations in Mexico, were being held here in compliance with President Taft's proclamation prohibiting explosive materials of all kinds from being taken across the border. Also there is the recurring danger of being "permitted" to "contribute" to the "cause," a procedure that is trying the spirits of the Americans almost to the breaking point. Many of the American mining employees have already left the country either by the advice of the managements or because of choice and this is greatly hampering all operations. Some of the companies have provided facilities for the families of their American employees to leave Mexico and in one case the whole mine staff is in the United States on salary, waiting for the return of safe conditions. It is difficult to get engineers to go into many parts of the country and as a result several negotiations under way when the last "war" started are likely to default. In one case the buyers are asking an extension because of their inability to have the property properly examined, but the owner refuses and will forfeit the payments already made. There is considerable concern as to whether the U. S. Government will adopt and enforce a vigorous policy to secure restitution of property lost by reason of the failure of the Mexican Government to maintain itself or to protect the contract right of Americans in Mexico which are now seriously jeopardized by the political difficulties which now affect a great portion of the country.

The strict enforcement of the recent inhibition on the export to Mexico of any explosives, and the actual closing of the port of Juarez to all exports will certainly and at once put a stop to all mining within the zone controlled by the Orozco force in the north of Mexico.

Cobalt

Mar. 22—The recent discovery of ore in the Keewatin formation of the Coniagas mine is exciting considerable interest, as this is the first time that any body of ore has been discovered in the Keewatin, in that portion of the camp. The drift on the vein has now been driven for a distance of 160 ft. beyond the contact, and the rich ore still continues, and will form an important addition to the reserves. C. W. Knight, assistant provincial geologist, has visited the mine, and states that the rock is undoubtedly Keewatin. About three years ago, at the Hudson Bay mine, a small shoot of ore was discovered in the same formation, but the returns were not sufficient to pay for the expense of working it.

The contract for grading the Elk Lake branch of the Temiskaming & Northern Ontario Ry., 30 miles long, between Earlton and Elk Lake, has been let to the Toronto firm of McCafferty & McQuigge for $180,000. The construction will necessitate the building of two large trestles. The company's engineers have announced a grade of six-tenths of 1% over the country to be traversed.

Toronto

Mar. 23—The Ontario Government has decided to postpone legislation limiting the working day for miners to 8 hrs. There were two bills before the House dealing with the matter, one introduced by Premier Whitney, the other by N. W. Rowell. When the latter measure came up, the Premier stated that he had been in favor of the 8-hr. day, but found that he had been too precipitate, and that there should be careful investigation before such a measure is enacted. The debate was adjourned, but the stand taken by the Government insures the defeat of the bill.

Hon. W. H. Hearst, Ontario Minister of Lands, Forests and Mines, has introduced into the legislature a bill making numerous amendments to the Mining Act. Sanitary provisions are made more stringent, and the responsibility for accidents is placed more definitely upon mine owners. Code signals are simplified, and it is made an offense for any one intoxicated or carrying liquor, to enter a mine. An extension of time for the performance of development work is provided if expiration falls due between Nov. 16 and Apr. 15. Mine owners may acquire the right to bring in water, drain and cut roads or tramways through adjoining lands, on paying compensation as fixed by the mining commissioner.

Porcupine

Mar. 22—Arrangements have been made for carrying on the construction of the power plant at Waweatin Falls, which was started by A. E. Wallberg & Co. This firm got into financial difficulties and was forced to abandon the work temporarily, but it is understood that Montreal men are furnishing the money to carry it to completion. This matter is one of great importance to the future of the Porcupine district, as with only one company supplying power, the rates would probably be higher. At the present time the plant at Sandy Falls is short of power, on account of low water in the river and the leakage from the dam; no change for the better is expected before a general thaw sets in. The mines using electricity have steam power in reserve in case of emergency, and several of them will be run by steam until the electric current is again available.

Operations at the Dome mine have now progressed to the point where the mill is ready to start. The tube mills were turned over yesterday, and some of the stamps would have dropped had it not been for a shortage of water, due to the breaking of one of the pumps. This will, however, be replaced in a short time, and the mill will be treating ore before the end of the week. There are over 1500 tons of ore in the bins, and everything at the mine is in readiness to supply the necessary tonnage. For about a week, more than 150 tons per day will be treated, but this will be increased to approximately 400 tons. On Mar. 30, visitors will be allowed to see the underground workings, which will be the first time anybody has been given this privilege.

Johannesburg

Feb. 8—The output for January was a record one but was obtained by adding nearly £100,000 worth of reserve gold to the month's output, it having been decided by several companies, including the East Rand Proprietary Mines, Ltd., to abandon the practice of keeping reserve gold, which appears always to have been a needless practice, as reserve gold can easily be accumulated in the battery or cyanide works in the form of precipitate in the boxes or gold amalgam on and off the plates. The East Rand Proprietary declared nearly £70,000 of such reserve gold, the retention of which meant a large loss of interest.

The Mining News

The Current History of Mining

Alaska

A large undertaking for the development of placer ground near Cordova is contemplated by Col. John Peter Grant and C. E. Campbell, now at Cordova.

It is reported that a power company is being formed to install a plant in the Knik district; this would be of considerable benefit to the mines in that vicinity.

A gold shipment of $30,000 in bullion was received at the Seattle assay office, Mar. 20, coming from the Nome, Fairbanks and Copper River districts.

Midas—The first shipment of ore from this property near Valdez was made recently, consisting of 260 tons, assaying 12% copper, $3 gold and $4.50 silver per ton.

Golden Hills Consolidated—This company has recently been organized and has taken over two groups of quartz claims in the Willow Creek district. It is the intention to place a crew of 25 men at work soon, and to install a stamp mill. H. D. Cowen, of Seattle, is general manager.

Alaska-Mexican—During January the mill crushed 19,803 tons of ore yielding $65,801 gross and net $31,349. Operating expenses were $31,364; construction, $3087; development, 290 ft. The ore averaged $3.36 per ton.

Alaska-United—During January the mills crushed 39,067 tons of ore yielding $89,073 gross and net $27,047. Operating expenses were $58,048; construction, $3976; development, 597 ft.; yield per ton at Ready Bullion mill, $2.29 and $2.31 at the 700 Claim.

Arizona

Gila County

South Live Oak—The company is preparing to begin exploration of its property with churn drills. Harry Millard, who will have charge of the drilling, has gone to St. Louis to purchase a "St. Louis" churn drill, made by the St. Louis Machine & Tool Co. It will have a 58-ft. derrick, with boiler and engine separate from the rig and is designed for deep drilling. Holes will be started with a 16-in. bit, which is 2 in. larger than the largest size now in use in the district.

Barney—Hole No. 1 is 1355 ft. deep and is still in the iron-stained, silicified schist formation in which it has been for the last 255 ft. This is the deepest hole ever drilled in the district, breaking the record of 1285 ft. made in Hole No. 1 at the Southwestern Miami. The 3-in. casing is being put in and Supt. E. B. Tinker expects to be able to attain a depth of at least 1500 ft. Hole No. 2 is 300 ft. deep.

Inspiration—The experimental mill has been temporarily closed to make some changes preparatory to starting another series of tests. The tests are carried on under the constant supervision of J. M. Callow, consulting metallurgical engineer. Work is progressing on the plans for the concentrator and it is believed that one of the many possible sites will soon be selected. The work on the dam across Pinal Creek has been delayed by the recent rains and consequent high water. The water well on the Inspiration Ranch opened a flow of 750 gal. per minute.

Sho Me—This group of seven claims, south of and adjoining the claims of the Inspiration company, is being developed by Cleve W. Van Dyke, president of the Miami Townsite Co. The claims are traversed by a large fault of which the foot wall is Pinal schist and the hanging wall, Gila conglomerate. A shaft 165 ft. deep, sunk on this fault, is reported to have disclosed about 2 ft. of red, hematite-stained, clay gouge and fault breccia, carrying native copper. The shaft is now being cleaned out and repaired. A second shaft has been started on the No. 2 claim but has been delayed by the recent rains.

Arizona Commercial—The retimbering of the Copper Hill shaft has been completed for 210 ft. below the collar. The present plan is to continue the work to the 400-ft. level and to start development work. Considerable ore has been shipped from this level in the past. Twenty men are employed under Superintendent R. R. Boyd.

Duquesne—This group is being worked by John Shaw with five men. The last shipment of 36 tons assayed 1.02 oz. gold and about 10% lead, netting more than $17 per ton above freight and smeltery charges.

Arizona-Colorado—The mine, three miles north of Globe, now owned by the German Copper Co., is being unwatered preparatory to resuming development work. The property consists of 21 claims, traversed by a strong fissure vein in diabase, quartzite and limestone. The principal opening is a vertical shaft 900 ft. deep, from which crosscuts to the vein have been run at several levels. It is claimed that 50,000 tons of chalcopyrite ore have been developed on the 800-ft. level, assaying 2½% copper.

Maricopa County

Vulture—A new oreshoot has been found in this old mine near Wickenburg. The mine was recently reopened and equipped with a new mill by Boston men.

Pima County

Old Yuma Mining Co.—George H. Dailey has taken an option on this property, in the Amole district, owned by Mrs. W. H. Barnes, of Tucson. The mine yields gold and vanadinite.

California

Inyo County

X-Ray—This mine is producing high-grade shipping ore. Three cars of ore are on the dump and one will be shipped for testing. An air compressor and machine drills are contemplated. A. E. Williams is manager.

Estella—A milling and concentration plant and some other machinery have been ordered from the Allis-Chalmers company. Surface buildings are being erected. A vein of lead-silver ore was disclosed several months ago at 3750 ft. in the 400-ft. tunnel. Estella Mining Co. is owner, and R. C. Troeger, Keeler, is president.

Kern County

Four Ace—This company has recently developed high-grade ore at the 300-ft. level of the Santa Ana mine, in new ground. This disclosure is taken as evidence that the ore in this district goes to depth, contrary to general opinion.

United Oil Co.—A new contract with the Standard is reported for 500,000 bbl. of the company's production in the Midway field. The price is said to be 50c. per bbl. without limit as to daily deliveries. The former contract was at 45c. and the daily deliveries were limited to 1000 barrels.

Great West—No. 1 well in Tappo Cañon, in the Piru field, is reported to have 33 gravity, green oil at 1000 ft., and to be pumping 20 bbl. per day. All other oil in the vicinity is black.

Mariposa County

Original—The flumes and ditches for the new electric power house have been completed, and the latter is in course of construction. W. G. Eganhoff, El Portal, is superintendent.

Crown Lead—The new transformer has been installed. The 20-stamp mill has

been idle for several weeks, but is now ready to start. G. S. Ireland is superintendent.

NEVADA COUNTY

Champion—The electric pump is being installed on the 1800-ft. level to lift water from below. From that point the pumps in the Providence will lift the water to the drain tunnel.

W. Y. O. D.—The 5-throw electric pump is in operation. This pump was in course of installation when the fire which destroyed the surface plant several weeks ago, retarded the work. It has a capacity of 500 gal. under a vertical lift of 600 ft., and is operated by a 150-hp. motor. Its position is in the 1100-ft. level. The pump was made by a local manufacturer, and is said to have cost $10,000. The Pennsylvania Mines Syndicate is the owner.

PLACER COUNTY

Gaylord Mining Co.—The reconstructed dredge, formerly operated in the American River district, at Natoma, is expected to be in operation soon at Whiskey Bar below Rattlesnake bridge on the American River. The dredge was rebuilt by the Union Iron Works. E. C. Gaylord, of Auburn, is manager.

Cache Rock—The Holmes system of gold-saving tables is being installed in this dredge by the Cache Rock Dredging Co., that has leased the boat and the placer claims from the owners. A. W. Copps, of Alameda, is general manager, and C. T. Schooler, Forest Hill, is superintendent.

SACRAMENTO COUNTY

Union Dredging Co.—The new 9-cu.ft., bucket-elevator dredge, Bucyrus type, has been placed in commission at Blue Ravine, two miles from Folsom in the American River district. The dredge is driven with General Electric motors, and is designed to dig 55 ft. below the water line. The first day the run was continuous for 16 hr.; the second day, 22 hr., an unusual start. The ground to be dredged embraces about 250 acres. Benjamin C. Warnick, 131 S. Fourth St., Philadelphia, is general manager, and Andrew Turner, of Folsom, is superintendent.

SHASTA COUNTY

W. J. Bright is operating a dry-land dredge on the Lanyon land near Copley, the latter town being on the Sacramento River north of Redding and west of the Old Diggings mining district.

SIERRA COUNTY

Phoenix—Extensive development work has begun at this Sierra City mine. A. Wise has charge.

Standard—This mine in Sailor Ravine is about to be taken over and equipped by a strong company composed of San Francisco, Colusa and Downieville men. J. S. Frye will remain in charge.

Hayes Consolidated—A bond has been given on this Sierra City mine, to a San Francisco company that will install power drills and extend the tunnel at river level to cut at greater depth the veins encountered in the upper workings. Thomas C. Heide is superintendent.

SISKIYOU COUNTY

Osgood—The lower tunnel is in 100 ft. with 14 in. of good quartz in the breast. Preparations are being made to install machinery. Mr. Harrison of Yreka, is superintendent.

TUOLUMNE COUNTY

If I Can—Grading for the two water tanks is under way. Water will be pumped from the river, and the mill of 200 tons daily capacity will be supplied from the tanks. The Stanislaus Gravel Mining Co. is owner, and E. R. Abadie, Jamestown, is superintendent.

Colorado

BOULDER COUNTY

United States Gold Corporation—The cyanide mill at Sugar Loaf is nearly completed, and the mine has been developed so that a steady supply of ore will be furnished. Power will be supplied by the Central Colorado Electric Co. George W. Oats has personal charge of the mining and milling operations on the ground, and John R. Wolff is general manager. The capacity is 150 tons per day. The Livingstone property, generally known as the "Potato Patch," has been acquired by the company.

CLEAR CREEK COUNTY

Santiago—A strike of silver-lead ore is reported at this mine in the Argentine district. It was made in sinking from the fourth level. An aërial tramway eight miles long is projected, and it is said this will reduce the cost of delivery from $4 to 50c. per ton. Twenty men are employed.

Specie Payment—The mine in Virginia Cañon is to be developed extensively by the Specie Mining, Drainage & Tunnel Co., just incorporated. John Owen, of Idaho Springs, is manager.

Centennial—This mine on Leavenworth Mountain was recently reported as sold to a Boston syndicate; work will be resumed soon.

CRIPPLE CREEK DISTRICT

Cresson Consolidated—The output is about 1500 tons per month of $25 ore, and enough ore is reported broken on the 11th level to keep up this tonnage for a year. This orebody has been shown to exist at the 12th level, 1274 ft. deep, and sinking of the shaft has been resumed. Richard Roelofs is manager.

El Paso—Development is progressing rapidly in the levels drained by the tunnel. A large 20x48-in. cylinder, Webster-Camp-Lane hoist has been ordered, and will be placed at the Nicholls shaft to enable following the water down as it recedes, and to develop the territory at the north end. This will eventually be the main working shaft.

Chickenhawk—Superintendent Walden has taken a lease on the property of the Katinka Co. and has started up the Chickenhawk mill.

Lexington—The annual report of H. J. Anstie, president and general manager, shows a cash balance of $6905 and no debts.

LAKE COUNTY—LEADVILLE

Nearly all the zinc-producing properties in Leadville are shipping and the tonnage is larger than for some time past; many properties that have never yet shipped any zinc ores are now entering the list. Owing to the tremendous snowfall and heavy condition of the roads not half the tonnage produced is being moved and it will be at least six weeks before this condition is improved.

Yak—The shipments from this tunnel are about 10,000 tons per month with 30 lessees at work and the breast is now in Vegas territory.

Stars Consolidated Mines—The output from the different properties is between 4000 and 5000 tons per month of different classes of ore, chiefly zinc and iron.

OURAY COUNTY

Camp Bird—During the quarter ended Jan. 31, 1912, the mill crushed 15,760 tons of ore, yielding gross $466,549 and net $350,682. About 65% of the ore treated was drawn from reserves in stopes, and on Jan. 31, the total ore broken in stopes amounted to 4017 tons.

SAN JUAN COUNTY

The Durango smeltery of the American Smelting & Refining Co., which was closed in November, was reported blown in again on Mar. 18, and is expected to run at full capacity all summer, as the ore supply is large. During the idleness caused by the floods which stopped ore shipments, the smeltery has been thoroughly overhauled and improved.

Intersection—Equipment has been hauled to the mine for enlarging the mill. Another battery of stamps is to be added and it is probable that an endeavor will be made to cyanide the coarse tailings by percolation.

SAN MIGUEL COUNTY

It is stated that nineteen 4-horse teams have been busy during the winter hauling vanadium ore from Paradox Valley in southwestern Colorado to the railway at Placerville, where there are three warehouses for storing vanadium and carnotite ores, that were built by the companies operating in the valley.

Colorado Carnotite Co.—The company is considering the installation of equipment for the concentration of its ores. It is said that recent experiments have

been successful in making a chemical concentration of the uranium minerals. O. Barlow Willmarth, general manager, has lately purchased additional claims, which will be developed soon by J. E. Snyder, superintendent.

Primos Chemical Co.—This company treated an average of 23 tons of vanadiferous sandstone daily during 1911, containing an average of 2½% V_2O_5. The mill at Newmire is at present treating 30 tons per day. A new roaster of the Edwards type has been placed in commission. The company is developing extensively on both sides of Bear Creek and has driven in over 1200 ft. on the east side, showing the vanadium-bearing sandstone to be practically continuous. Much of the product is marketed in Europe, where sales of ferro-vanadium at $2.25 per lb., for the metallic vanadium content, are reported. The prevailing price last autumn was $3.50 per lb. Thomas Bradley, New Placerville, is superintendent.

SUMMIT COUNTY

Wellington—A new 25-ton magnetic separator, to treat the zinc middlings said to cover an acre to a depth of 20 ft., has been completed by this company. It is believed that this product can be treated at a net profit of about $4 per ton.

Idaho

BOISE COUNTY

Boston-Idaho—This company is running its two dredges at Idaho City, and reports state that the ground is unusually rich. The company has also taken a bond on the Banner mine, and the caved tunnels are being opened. If conditions warrant, the company will extend its power line to this property.

Twin Sisters—The mine was sold recently to Youngstown, Ohio, men.

COEUR D'ALENE DISTRICT

Snowstorm—An official report issued recently shows the mine to be in excellent shape. At present, 200,000 tons of sulphide ore, averaging 4% copper, are blocked out between Nos. 2 and 3 tunnels, and 45,000 tons of carbonate ore above No. 2 tunnel. Ore is being shipped from the latter regularly. The sulphide ore will be stoped when the first 100-ton unit of the new mill is ready; this will probably be about Apr. 15. The advance in the price of copper is largely responsible for the renewed activity at this property. The ore is a highly siliceous copper ore and was in great demand by smelters before magnesia brick came into such universal use. The new method of treatment, concentration and leaching, is expected to make the mine a large producer.

Sunset—Development at this property is progressing satisfactorily. A night shift has been added to the working force.

Marsh—This mine, at Burke, has completed 300 ft. of two-compartment shaft. A station and skip pocket will be cut and a crosscut driven to intersect the vein. Lumber is on the ground for the erection of an orebin at the mine, and when completed, it is the intention to start the mill. The mill is on Nine Mile Creek, about two miles from Wallace.

Hercules—Work in No. 5 tunnel is being pushed. When completed, the tunnel will be about 8000 ft. long and will utilize about 1900 ft. of the old Humming Bird tunnel. The latter is being widened and retimbered, about 1500 ft. of this work being completed. A feature of the work is a 24-in. ventilating pipe to carry off the gases.

LEMHI COUNTY

D. A. McDonald, H. W. Lohman and O. J. Potter, of Breckenridge, Colo., are prospecting Bohannon Bar with a No. 3 Keystone drill, and a dredge may be installed this summer.

Parker—This company, operating at Parker Mountain, has purchased the 10-stamp mill belonging to the Cinnabar mine and it is being transferred to the property. Judge Stevens, T. R. Jones and F. J. Cowen are the owners.

Illinois

American Zinc, Lead & Smelting Co.—This company is offering to its shareholders 70,000 shares of stock at $26.50 per share, the whole issue having been underwritten by Hayden, Stone & Co. for a commission of $1.50 per share. Of the expected $1,750,000 proceeds of this stock, about $1,000,000 will be used to pay for the new smeltery at Hillsboro, Ill., which is expected to be completed about July 1, and $500,000 will be used for the equipment and construction of a mill at the mine in Tennessee that is now under development.

Michigan

COPPER

Mohawk—No. 6 shaft is down to the sixth level, which corresponds with the ninth level of the other shaft, and it is opening ground of unusual richness for this company. This shaft adjoins the Ahmeek, and the character of the ground corresponds in all respects with that of the Ahmeek at the same depth. It commands much territory and will be a large factor in the future of this property. Conditions underground at No. 5 shaft are showing a material increase in the copper content of the rock.

Hancock—The sinking of the large vertical shaft continues, stringers of copper have been in evidence for some time, and it is expected that the Pewabic lode will be reached at any time. It was first estimated that the lode would be reached at a depth of about 3600 ft., but the lodes affiliated with the Pewabic have been reached sooner than was expected, and it is now believed that the formation has flattened and that the Pewabic lode will be reached at a shallower depth.

Ojibway—The crosscut from the 1600-ft. level of No. 2 shaft has encountered the lode, but has not as yet reached the hanging-wall side. The ground so far broken is of good character and well mineralized.

Osceola—The hearing in the injunction case of Charles M. Turner, who secured a restraining order against the holding of the annual meeting, has been called for Mar. 28, at Lansing, before Judge Weist, of the Michigan Circuit Court.

Mayflower—The report for 1911 shows receipts of $62,148 and expenditures of $23,599, leaving balance, Jan. 1, 1912, of $38,548. During the year 7294 ft. of diamond drilling were done. The following directors were elected for 1912, at the annual meeting: George E. Clarkson, Alton L. Dickerman, H. F. Fay, George P. Gardner, Frederic W. Nichols and Charles J. Paine, Jr. The St. Mary's company owns 25,000 shares of Mayflower stock and is expected to take an active part in the future management of the property.

IRON

Iron County Steel Co.—Operations have begun on the properties at Iron River. At the Lennox mine ore is being hoisted and exploration work is being started, to be carried on at the same time as the mining operations; the property has a shaft and about 35,000 tons of ore, which was blocked out by the Brule company, from whom the property was secured. The Cyr property, consisting of 40 acres, will be explored from the underground workings of the Lennox. At the Corry property, east of the Berkshire mine of the Brule Mining Co., equipment is being delivered. On Sec. 34, southwest of Iron River, a shaft is being started.

Winckler—George H. St. Clair, of Minneapolis, is diamond-drilling on this 60-acre tract, north of Iron River, for a private organization in which he is interested. Ore has been found near the property's north line, which also forms the south line of the Wauseca or Konwinski mine, of the Mineral Mining Co. The property includes the N. E. ¼ of the S. W. ¼ of Sec. 23-T. 43—R. 35, and the West ½ of the N. W. ¼ of the S. E. ¼ of the same section. The other one-half of the latter forty is held by Powers & Geary, of Hibbing, Minnesota.

Lucky Star—At this property, at Negaunee, to be operated by the Breitung interests, arrangements are being made to start shaft-sinking; machinery is being ordered, including a 700-ft. air compressor. It is planned to use small "plug"

hammer drills in the sinking. Electric power will be furnished the mine by the Cleveland-Cliffs Iron Co., from its new Carp River plant; the latter company owns a minority interest in the Lucky Star company. The ore shipments will be forwarded over the Lake Superior & Ishpeming Ry. to Marquette, as will probably the coming season's output from the other Breitung mines; this railroad, also owned by the Cleveland-Cliffs company, is completing a new steel and concrete ore dock on Lake Superior, just north of Marquette.

Missouri

Greene County

Bray—This zinc-lead property, south of Springfield, is being operated under lease by a Kansas City company, under direction of George Mutscheler.

Badger—This mine near the Bray has been acquired by the Shoto Mining and Milling Co., of Springfield, and is being reopened. A mill has been completed to treat the zinc-lead ore. F. F. Griffin is manager.

Montana

Butte District

Davis-Daly—On account of the continued improvement, with development, it has been recommended by General Manager Fisher, that all attempts to acquire new property, commenced some months ago when underground conditions were discouraging, be abandoned for the time being, at least. Ore assaying 10% copper was recently encountered on the 1700-ft. level of the Colorado mine. During the last four months, gross earnings have been amounting to between $15,000 and $20,000 per month. These have been practically paying expenses and it is thought by the management that the output for March will leave a small profit in the treasury. Arrangements have been made with the Anaconda company whereby a crosscut will be driven from the 2000-ft. level of the Gagnon mine to develop the practically unexplored western end of the Davis-Daly property. Shaft-sinking was continued from the 1700-ft. level, Mar. 1, and will be continued to the 2000-ft. level.

Pilot-Butte—Considerable development work is being done, most of it with good results. Two veins, running well in zinc and silver, have been opened on the 900-ft. level, one north and the other south of the shaft. Also a crosscut is being driven on the 900-ft. level to intersect the Snowball vein, which passes through the North Butte ground. A body of zinc and silver ore has been opened on the 1300-ft. level in the drift from the Butte & Superior workings through the Pilot ground, assaying 26% zinc, 44 oz. of silver and $1.50 in gold per ton.

Jefferson County

Boston & Corbin—The directors are planning the erection of a concentrator at the property near Corbin, and to this end the mine was thoroughly sampled recently and a car of average ore was sent to the Anaconda sampling works with instructions to forward one-half of the car to the General Engineering Works at Salt Lake City as a check sample; it is hoped in this way to determine the most suitable plant for that character of ore. Returns gave an average of 3.6% copper, 7.1 oz. of silver, and 20c. in gold. It has been figured that the gold and silver will just about pay the cost of mining the ore, leaving the copper as profit, in case the concentrator is built, and it seems likely from these encouraging figures that work will be started soon on its erection.

Lincoln County

Blacktail—This gold property will be operated this year by A. M. Balfour and associates, under lease. The property is equipped with a stamp mill and is in the West Fisher district, 35 miles south of Libby.

Big Eight—A small force of men is doing development work on this silver-lead mine in the Troy district.

Lincoln Gold Mining Co.—This company, owning the Sylvanite gold mines, 16 miles north of Troy, has sawed lumber during the winter for the mine buildings which were burned in a forest fire in 1910. An attempt is being made to get the company's affairs in shape to rebuild the mill and to resume operations. J. H. Ehlers of Spokane has charge of the work. The mines were being operated steadily at the time of the fire.

California-Montana—This placer mining company expects to put in a hydraulic plant on Libby Creek this year; it controls about 800 acres of land. The company has been prospecting the ground with a steam drill during the last winter and the reports that have been given out are favorable. W. H. Graham, of Libby, is behind this enterprise.

Nevada

Comstock Lode

Con. Virginia—The annual meeting of stockholders was held last week, and the old management was retained by a large majority. B. F. Shaw was chosen president, and, with Edward S. Spring, Herman Zadig, A. F. Coffin and H. L. Slosson, Jr., constitutes the board of directors. Charles H. Fish retired from the presidency after serving for many years, and was succeeded in the board of directors by Mr. Slosson. Thomas F. McCormick was reëlected superintendent.

Mexican—A cleanup was made of one of the large tanks recently, and the bullion obtained was shipped to the smeltery. During the shutdown for this purpose, a new liner was placed in the tube mill. The tonnage treated at the plant has been increased.

Union Consolidated—A south drift was started last week from the west crosscut at the 2500-ft. station of the joint winze, but was stopped on account of the free flow of hot water. The drift will follow the wide vein opened by the crosscut, and work will be resumed when increased pumping facilities are available. A new pump station is being cut in the winze, between the 2000- and 2500-ft. levels, and the water will be taken out in two lifts. A northwest prospecting crosscut has been started in the north drift from the Mexican side of the mine, at a point about 60 ft. north of the old Patton east crosscut. The vein formation will be explored in that direction.

Best & Belcher—The new hoist and other equipment for the Sutro tunnel station have been installed, and sinking of the joint winze was started a few days ago, three shifts being employed in the work. This winze will be sunk to the 2400-ft. level.

Clark County

Quartette—The only work in this Searchlight mine for nearly a year has been exploration in the lower or 1300-ft. level, to cut the oreshoot to the east in the Rambler ground, purchased by the company two years ago for $30,000. Recently a number of leases have been let and some rich ore is being extracted, mostly from the surface or the upper levels. The tailings have been leased to C. H. Jonas, the cyanide plant is being remodeled to treat them, and a slime plant will be added. The new plant will be furnished by the Colorado Iron Works, and will contain a mechanical mixer, Akins classifier, paddle wheel, agitator, Portland filter and belt conveyors. The plant will be in operation by the middle of April. J. E. White is in charge.

Nye County

Tonopah ore shipments for the week ended Mar. 14 were: Tonopah Mining, 3450 tons; Tonopah-Belmont, 1950; Montana-Tonopah, 1050; Tonopah Extension, 1220; West End, 725; MacNamara, 435; North Star, 40; total, 8870 tons and $221,750 estimated value.

MacNamara—The cleanup of the 10-stamp mill for a 16-day run, ended Mar. 9, produced six bars of bullion worth $9643. The mill is treating 62 tons of ore per day, averaging $16 per ton.

Tonopah-Belmont—During the retimbering of the main shaft, shipments of smelting ore have been suspended, but the regular output of 2000 tons per week is being sent to the mill. On the 1100-ft. level, a south crosscut has cut a new vein showing 9 ft. of good ore. Below the 12th level work has been suspended, owing to the sinking pumps being too small to cope with an increased flow of water, and larger pumps are being installed.

Tonopah Merger Mining Co.—This company has acquired the old Golden Anchor mine, adjoining the Midway on the west, and under the management of John Kirchen, of the Tonopah Extension, will sink the shaft from a depth of 840 ft. to the 1050-ft. level, and develop two large veins in the property. The directors are: Key Pittman, Frank Pittman and R. T. Harris, of Tonopah, J. G. Butler, Jr., of Youngstown, Ohio, and R. C. Hall, of Pittsburg.

Tonopah Extension—The midmonthly cleanup for March resulted in the shipment of 21 bars of bullion, weighing 2645.5 lb., worth $29,100. The mill is now treating 155 tons per day. Next week the company will commence the sinking of a new three-compartment main working shaft, 1600 ft. west of the present shaft and 400 ft. west of its extreme western workings, in which extensive orebodies have been developed.

White Pine County

Ward—A committee of the minority stockholders has taken an option on this extensively developed lead-silver mine, south of Ely, until May 1, and is negotiating a sale of the property. When the property is operated again, it is proposed to built a short line of railroad to connect with the Nevada Northern R.R., at Ely.

New Mexico

Grant County

The total ore shipments from Lordsburg for February, were 4843 tons, a low monthly tonnage. In 1911 about $1,000,000 worth of ore was shipped from Lordsburg. The ore is all delivered to the railroad by teams and unusually bad weather interfered with hauling. Mining is more active here than for years.

Atwood Copper Co. — Preparations have been made to increase the output; heavier machinery has been installed and the shaft is being sunk from the 200-ft. level. Two veins are being worked on this level which has about 550 ft. of drifts and crosscuts on the two main veins. The ore in the smaller vein averages about 4 ft. wide and that in the larger vein is 12 ft. wide. The new hoist, headframe and ore bins are expected to be in commission within two months.

Oregon

Ashland—This gold mine east of Grants Pass has been sold to Minneapolis men. It is developed and equipped with a 10-stamp mill. It was formerly operated by Dr. R. O. Hall, of Los Angeles, and was sold to a Canadian company. It has been idle for two years owing to a cave on the lower levels.

Granite Hill—This property in Josephine County is being overhauled by the Oregon Gold Mines Co., and operations will be enlarged. The mine is on Louise Creek.

Rainbow—The erection of a mill on this property in Baker County is said to be under consideration, again.

South Dakota

Black Hills District

North Homestake—The shaft is 620 ft. deep and crosscuts are being run both east and west to intersect veins disclosed by diamond-drilling done from the upper levels.

Custer Peak—Sinking has been resumed at the Jungle mine of this company. Work was suspended at a depth of 90 ft. It is the intention to sink to at least the 200-ft. level. J. H. O'Brien, Albany, is superintendent.

Utah

Beaver County

Cedar-Talisman—Carbonate ore is reported on the 500-ft. level, and it is thought that the Stewart vein may have been encountered. A survey of the lower workings has been completed.

South Utah—Development is being done on the 600- and 700-ft. levels. The ore is being taken out through the 600-ft. level on electric trains. The grade of the ore is reported to have improved.

Emery County

A. Cameron is shipping carnotite from the San Rafael district. Mr. Cameron, who represents Philadelphia men, has recently purchased the interests of Elmer Dahling in this district.

Charles P. Tasker, of Philadelphia, has installed a drilling rig at Green River, and will exploit the extensive holdings of his company.

Juab County

Grand Central—During 1911, 26,216 tons of ore were shipped, bringing $186,302. The balance on hand, Jan. 1, 1912, was $9408. Since Jan. 1, 1912, the shaft has been sunk 125 ft., its present depth being 2325 ft., and a station is being cut on the 2300-ft. level. Ore has been followed 40 ft. below the 2200. No trouble from water has been experienced and none is expected.

Colorado—Development at depth in unprospected ground has been started through the Crown Point.

Iron Blossom—The average daily production for February is given as 360 tons, and the earnings for that month will probably exceed January.

Salt Lake County

Utah Copper—The Magna plant and seven sections of the Arthur mill operated at full capacity during February. A record output of 18,300 tons in one day was made.

Bingham-New Haven—Daily shipments of 200 tons are being made, with an additional 100 tons treated in the mill. The ore is said to carry about 3% copper, with about $5 per ton in gold and silver.

Summit County

Silver King Consolidated—The annual report, for 1911, shows assets of $1,123,037, including a judgment of $737,007 against the Silver King Coalition Mines Co., which, with interest, amounts to about $783,000. Receipts for the year were $100,241. The total number of shares issued is 344,058 out of a total of 500,000. The liabilities, including bonds and convertible notes, amount to $184,424. During the year ended Feb. 1, 1912, 469 dry tons of ore, averaging 40 oz. silver, 37.2% lead, 0.07 oz. gold and 0.6% copper were shipped, and brought smeltery returns of $18,678, the average net value being $41 per ton. Development work was continued in the Andes claim, and the above shipments were made from this ground. New ore has been opened below the 1550 level.

Tooele County

Lion Hill Consolidated—The annual report has been issued. During the year, 1859 ft. of development were done. Several cars were shipped for experimental purposes and brought net returns of $13,738, the ore running 105.19 oz. silver, $3.39 gold, and 4.5% lead. Total receipts were $44,653; expenses were $44,604. The balance due from the underwriters should be sufficient to continue development for some months.

West Virginia

United States Coal & Coke Co.—An explosion is reported to have killed 81 men, on Mar. 26, in the Jed coal mine of this company, at Jed, three miles from Welch.

Wisconsin

Copper

The only work underway on the western copper range is on the Weyerhauser property east of Minong, Washburn County. It is reported that the results are not encouraging. Exploration is by diamond drill.

Zinc-lead District

Beloit—The property of this leasing company, including mine and mill equipment and a lease on 80 acres near Cuba City, has been sold to Chicago and Milwaukee men, who will resume operations on a larger scale.

Wisconsin Zinc Co.—The company has taken over the Little Bennie tract at Benton and has commenced sinking a new shaft.

Vinegar Hill Zinc Co.—The company has obtained a lease on the Scrabble Creek property at Hazel Green and is drilling it.

Canada

BRITISH COLUMBIA

Shipments and receipts in tons in the Boundary district for the week ended Mar. 14 were as follows:

Mine	Week	Year to Date
Granby	25,112	243,003
Mother Lode	8,740	85,785
Rawhide	4,786	22,704
Jack Pot	152	3,669
Athelstan	....	340
Emma	436	4,901
Others	220	2,633
Totals	39,446	363,035
Smelteries		
Granby	25,112	288,672
B C. Copper Co	13,955	119,994
Totals	39,067	408,666

British Columbia Copper—The surface works at the Emma mine have been destroyed by fire. This has necessitated a temporary cessation of operations there. The loss is covered by insurance. More ore of good grade has been found in the Wellington group which includes the Athelestan, Fraction and Jackpot claims. Prospecting is resulting satisfactorily on two of the claims included in the Voigt group, Similkameen district, held under option of purchase. In a crosscut at 90 ft. depth, on No. 14 claim, 8 ft. of ore have been encountered; of this 2 ft. average $34 per ton. Assay returns of samples received in New York are copper 8% and gold 0.55 oz. per ton. Much good ore has also been found on No. 18 claim.

NOVA SCOTIA

Nova Scotia Steel & Coal Co.—The annual statement for 1911 shows profits of $1,019,392, the balance brought forward from the previous year being $500,602. After the payment of dividends, fixed charges, etc., and $73,880 for improvements to plant, a balance of $508,544 was carried forward to profit and loss account. The total reserve fund stands at $1,835,522. In their annual report the directors state that during the latter half of the year the iron and steel trade was much disturbed by American competition, owing to the low rate of duty. The increased efficiency of the plants owing to the considerable expenditures on improvements has reduced the cost of production.

ONTARIO-COBALT

Cobalt shipments for the week ended Mar. 22 were: La Rose, 276,400 lb.; Nipissing, 206,560; Right-of-Way, 87,460; Buffalo, 60,600; Crown Reserve, 36,120; McKinley-Darragh, 62,940; Coniagas, 40,780; total, 770,860 lb. Bullion shipments were: Nipissing, 96,906 oz.; Buffalo, 7679; Crown Reserve, 18,791; O'Brien, 9618; total, 132,985 ounces.

Hitchcock—The syndicate which has taken over this property at Elk Lake, on an option providing for the expenditure of $40,000 in development work, has begun operations and is putting machinery in.

Temiskaming—This company has declared its first dividend since the acquisition of the North Dome property in Porcupine. Ballot papers will be sent out with the dividend checks by which shareholders may express their opinions as to the North Dome purchase.

Mann—Fifteen tons of high-grade ore of an estimated value of $40,000, have been shipped from this property, at Gowganda. Free gold occurs in wire form with the silver.

ONTARIO-PORCUPINE

Jupiter—Good ore has been encountered on the 200-ft. level of this property.

Porcupine Gold—The No. 3 vein has been cut on the 200-ft. level.

Pearl Lake—The main shaft has reached a depth of 400 ft. and from this point a crosscut is to be driven south to intercept the veins which come in from the McIntyre property.

McIntyre—It is stated that the balance of the treasury stock is to be issued at about $5 per share, in order to provide funds for increasing the capacity of the mill. Mine conditions, however, do not appear to warrant the increase in mill capacity. The property has been partially closed down on account of lack of power.

Porcupine Union—This company, having disposed of sufficient treasury stock to secure adequate funds, is resuming work on three claims in the Three Nations district.

Davidson—The Crown Chartered has met the payment of $28,750 on this claim, due Mar. 9. A winze is being put down from the 100- to the 200-ft. level, and two raises, 50 ft. apart, are being driven.

ONTARIO-SUDBURY

Newton Cryderman, of Sudbury, is conducting explorations in the new Groundhog gold district, about 90 miles north of Sudbury. The oreshoots are reported small but rich in gold. The district will be accessible to the new route of the Canadian Northern Railroad.

Gosselin—Twenty-five men have been sent from Sudbury to begin operations on these claims, at West Shining Tree, and an equal number will follow when the camps are ready. Surface sampling shows an average of $11.90 per ton. Testpits will be sunk and diamond-drilling undertaken.

Mexico

BAJA CALIFORNIA

Gulf Copper Co.—The company owns the El Toro mine on Angeles Bay, Gulf of California, northwesterly from Guaymas, Sonora. J. H. Baker, San Diego, Calif., is president and C. E. Anthony is engineer. An adit is being driven to tap the old workings.

CHIHUAHUA

Grandeña—This mine at Santa Barbara will soon be reopened, using for ore beneficiation, a new zinc-treatment process, developed by the manager, Sewall Truax, who has been engaged for several months in experiments at Cañon City, Colorado.

MEXICO

Esperanza—During February the mill crushed 15,612 tons of ore yielding gross $102,539 and net $4273. Operating expenses were $92,145; depreciation, $5000; other expenses $1121; estimated profit $3042. Development work totaled 1301 ft. The small return is stated to have been due to the low grade of ore treated and low tonnage. The first half of March is said to show a satisfactory increase in both grade and tonnage.

NUEVO LEON

Zinc exports during February were suspended, due to the rise in ocean freight rates.

Soledad—This mine at Sabinas has again resumed operations after a short shutdown and is shipping about 1500 tons of lead ore per month.

Fraternal—This and the Minas Viejas properties are working at full capacity.

Dolores—The property at Vallecillo, which has been operated almost continuously since 1840, has been taken over under lease by James Morlan. The mine is under water up to the fifth level and during the last five years the mill has run on the old tailings dumps. The present intention is to unwater the mine and to work the stopes left in zinc ore by the former owners. According to the records these were important. Additional boiler and pumping capacity has been ordered and will be installed soon. The former management, which up to a few years ago was still working with a Cornish pump, was unable to lower the water. It is hoped that the new installation will result in a new lease of life for this important district.

SONORA

Santa Gertrudis—The Camp Bird company, owner, reports that during the quarter ended Jan. 31, 1912, developments continued to be satisfactory. The oreshoot on the 18th level is extending farther west than on the level above. The San Guillermo and Contra Tiro shafts are down to the 19th level and crosscutting to the vein is in progress. The present capacity of the mill, 600 tons, is to be increased to 800 tons per day. Estimated profit for the quarter was £53,924.

Asia

CHOSEN

Oriental—During January, 25,524 tons of ore were crushed, yielding $125,794 gross and net $45,188. Operating costs were $77,851; development and other charges, $2754. The Kuk San Dong 40-stamp mill was hung up all month on account of labor and fuel shortage. The East Candlestick 10-stamp mill was hung up seven days because of labor shortage in the mine.

The Market Report

Current Prices of the Metals, Minerals, Coal and Mining Stocks

Coal Trade Review

New York, Mar. 27—While the main interest still centers in the wage controversies, the markets have generally quieted down a little and are in better shape. It is now generally accepted that there will be some stoppage of mining on Apr. 1, both East and West; whether it will amount to a strike in either case is the question. Conferences continue, but in neither case has an acceptable compromise been reached. The whole matter remains in uncertainty.

Railroad conditions are better, and coal is moving more freely, though transportation is not yet satisfactory.

Inquiries for export are again reported, but a prospective—or at least possible—scarcity of coal here, and high ocean freights are against large shipments abroad.

The English strike continues, with no prospect yet of an early settlement.

The coal production of South Africa in 1911 was as follows: Cape Colony, 89,023; Natal, 2,682,029; Orange River, 482,690; Transvaal, 4,343,680; total, Union of South Africa, 7,597,422 short tons.

Fuel exports of Great Britain two months ended Feb. 29 were: Coal, 10,936,159; coke, 222,040; briquettes, 310,183; coal sent abroad for use of steamships in foreign trade, 3,066,978; total, 14,535,360 long tons, an increase of 1,181,237 tons, or 8.8%, over last year.

German Coal Trade—Exports and imports of fuel in Germany in January, metric tons:

	Exports	Imports	Excess
Coal	2,452,695	759,901 Exp.	1,692,794
Brown coal	5,246	591,830 Imp.	586,584
Coke	425,812	50,171 Exp.	375,641
Briquets	216,098	16,547 Exp.	199,551
Total	3,099,851	1,418,449 Exp.	1,681,402
Total, 1911	2,558,373	1,261,344 Exp.	1,297,029

The exports this year included 1853 tons coke to the United States.

Coal production of German Empire month of January, metric tons:

	1911	1912	Changes
Coal	13,527,215	14,565,606 I.	1,038,391
Brown coal	6,319,544	6,865,208 I.	545,664
Total mined	19,846,759	21,430,814 I.	1,584,055
Coke made	2,231,865	2,340,366 I.	108,501
Briquets made	1,789,128	1,922,021 I.	132,893

Of the briquettes reported this year 1,497,060 tons were made of brown coal or lignite.

Belgian Coal Trade—Coal production in Belgium for the year 1911 was 23,125,140 metric tons, a decrease of 702,000 tons from 1910. Imports of fuel were: Coal, 7,315,024; coke, 671,533; briquettes, 381,087; total, 8,367,644 tons, an increase of 1,156,312 tons. Exports were: Coal, 5,168,017; coke, 1,027,081; briquettes, 529,626; total, 6,725,444 tons, an increase of 174,235 tons.

Iron Trade Review

New York, Mar. 27—Business in the iron and steel markets is still on a large scale. Specifications on contracts are generally good, and new business is inclined to be better. The railroads are ordering more, especially in cars and bridges. Sheets and plates are active, though bars and wire are rather easier, so far as selling is concerned. Mills are beginning to stand out for higher prices, and quotations have firmed up in some degree, without showing marked advances. Third-quarter business is not making much show yet, buyers being unwilling to contract on advances which the mills are inclined to ask. The exception is in structural steel, in which there is a sharp competition for the larger orders. Fabricating concerns are naming very low figures to secure contracts.

Pig iron is again active. In Eastern territory both foundry and basic are being bought well. In the Central West basic is in good demand and some sales of bessemer are being made. In the pig-iron market, as well as in finished material, there has been some firming up of prices; here, likewise, there is some hesitation over third-quarter contracts on the price question.

An adjourned conference on the steel-rail question was held in New York, Mar. 21, delegates from a number of railroads and from the rail mills being present. No conclusions were reached after a long discussion and a committee was appointed to see if common ground could not be found to formulate new specifications.

Baltimore

Mar. 25—Exports for the week included 3,368,180 lb. steel billets to Liverpool; 882 lb. selenium and 1,024,200 lb. galvanized pipe to Hamburg; 2,687,400 lb. steel rails and 132,281 lb. angle-plates to Antilla, Cuba. Imports included 30 tons spiegeleisen and 3610 tons ferromanganese from Middlesboro, England; 4400 tons manganese ore from Batum, Russia; 23,165 tons iron ore from Cuba.

Birmingham

Mar. 25—While Southern furnacemen are holding their product for $10.50 per ton, No. 2, foundry, there are reports of sales at $10.25 right along. The manufacturers in this section of the country are selling more than their make. The records show that from Dec. 1 to Mar. 1 there were no less than 50,000 tons of pig iron removed from the accumulated stocks of iron in Southern furnace yards, while since Mar. 1 it is estimated that the amount has been increased to at least 75,000 tons. At that rate it will not be many weeks now before the yards will be bare and the market will be strengthened considerably. Inquiries for pig iron are numerous, especially for delivery during the last half of the year. While purchasers are willing to pay $10.50 per ton, No. 2 foundry, the manufacturers are not yet willing to make a price for the product. There is still considerable furnace repairing going on and all arrangements are being made to increase the output when it is needed, with no immediate prospects of such a condition.

The home melt is holding up well, cast-iron pipe plants doing well and shipping pipe at a lively rate. The steel industries in Southern territory are doing fairly well. Scrap iron is a little better, too, while the brass foundries are doing well on furnace repairing. Charcoal iron holds at $22@22.50 per ton with the demand a little slow now.

The Tennessee company has blown in a furnace in the Birmingham district on foundry iron.

Coal operators in the Southern territory are not expecting any labor troubles next month, very few union miners working in this part of the country.

Chicago

Mar. 25—The iron market is considerably firmer in tone. Sales of pig iron are larger than for several weeks and there is a general feeling of encouragement over the numerous inquiries, some for large tonnage requirements in the last half. There has been yet, however, no increase in prices. Southern No. 2 brings $10.50, Birmingham, or $14.85, Chicago, and Northern No. 2 $14, at furnace.

Sales run from 200 to 1000 tons—a few up to 2000 tons, and are chiefly of coke iron, though charcoal is fairly active at $16.50. The demand is uniformly manifest throughout the trade, indicating gen-

eral betterment of trade conditions among the melters. For the last-half needs, 25 or 50c. above current prices is asked, and selling agents are confident that they can be obtained. The demand for small lots, for early delivery, is gradually giving way to larger orders and more distributed deliveries.

In the market for iron and steel products there is more activity, with larger contracts made for structural material on bridge and building work generally. Beams and channels up to 15 in. hold to 1.28@1.35c., with the average price about 1.30c. Bars are firm at 1.25@1.33c. for soft steel and 1.15@1.20c. for iron bars, with the demand increasing. Railroads seem to be coming surely though gradually into the market; sales of rails are light and of track fastenings good. Billets are quiet at $26.50@27 for open-hearth. Plates are in better demand at about 1.30c. for ¼-in. tank plates, and minor lines are in good condition. Business generally is improving; all indications are for a slow but solid increase of sales.

Cleveland

March 26—It is stated that Corrigan, McKinney & Co. have made contracts to move ore from Duluth to Cleveland at 55c., with an unloading charge of 15c., making 40c. net to vessels. The charters provide that if the unloading charge is decreased a corresponding decrease shall be made in the rate. As it is now pretty sure that the unloading figure will be 8c., the total freight rate will be 48c. per ton.

Pig Iron—A number of inquiries have been received for basic in small and large lots. Prices are nominally unchanged but are perceptibly firmer.

Finished Material—A number of orders have been received. They are generally small, but aggregate a good tonnage. Prices are a little firmer, but not generally advanced. Little contracting has been done yet for third quarter.

Philadelphia

Mar. 27—The improved buying movement in pig iron indicates at every point a continuance of the activity of the past week. Quotations are firm; concessions are the exception and inquiries are on the increase. After a long lull in demand basic iron is once more active though most of the business for the week is the result of inquiries and negotiations which originated from two to four weeks ago. Taking a conservative view of the situation it is probable that a large tonnage covering all kinds of crude iron will be closed before Saturday or early next week, in which several of the better grades of Southern iron will participate. While the tone of the market is stronger there is nothing to indicate a general buying movement beyond the reasonable requirements of the consuming trade. Foundry No. 2 is moving as about last week; on quotations close to $15, with forge at $14, sometimes a little better, and basic at about $14.25. More liberal offerings of Southern iron are being made.

Billets—Billets are selling more freely owing to the appearance in the market of a large number of small buyers.

Bars—Owing to the opening of the spring trade bars are somewhat more active for immediate delivery and an improvement is reported at nearly all mills. There is no effort made to exact outside quotations when business is in danger of slipping to some other mill.

Sheets—The volume of business in sheets is maintained, especially the duplication of orders from the larger buyers. Galvanized is more active than any other kind.

Pipes and Tubes—Tubes maintained their strong hold but the orders of the week are rather trifling. Merchant pipe is quiet. Cast pipe is very active and mills are working practically to capacity.

Plates—Prices have been advanced on all small business and the advance is regarded as permanent. Some inquiries which have been hanging fire for perhaps a month have resulted in orders this week.

Structural Material—Orders for bridge work are limited mostly to small quantities for summer delivery. Prices are notably stronger; the latest quotations show that the manufacturers think about $2 a ton advance a fair value. Large buyers in the market express the belief that the present nominal advances will not be held.

Scrap—Scrap is hardening in price, especially in steel and No. 1 railroad as some quiet buying has just been closed which cleaned up the immediate stocks.

Pittsburg

Mar. 26—The volume of specifications for finished-steel products since last report has been larger than at any previous time this year and has probably been larger than at any time during the November-December movement. Some of the important steel interests find their actual bookings of orders larger than at any time for nearly two years, and the general position is probably in conformity with this experience.

The business being entered at this time is regarded as of the most solid character and is believed to represent a well established movement, being quite different from that which occurred toward the close of last year, when buyers were covering against contracts which were about to expire. The steel mills of the Pittsburg district and eastern Ohio are operating at practically full capacity, for the first time since the early summer of 1910, and many of them are already making new records for output.

Prices are showing an advancing tendency, though not a rapid one. Throughout this improvement, which has extended almost without a break from the first improvement last August, the mills have shown a remarkable lack of backbone, prices often yielding even in the face of increased demand, but at this time the actual conditions are tending to force prices upward, as the existing capacity is practically all engaged. A number of paper advances have been made in the past fortnight, mills advancing their open quotations but being willing to make concessions from these quotations in the case of good orders. The net outcome, however, is a slightly higher realized average on the fresh sales. A few low-priced contracts expire April 1, and it may be estimated roughly that the average realized price on shipments of bars, plates, shapes, sheets and wire products will be fully $1 a ton higher than the average in the quarter just closing.

Pig Iron—The pig-iron market has been rather quiet since the somewhat spectacular movement in bessemer and basic iron, but there is a strong undertone, as the merchant furnaces are well sold up and the fuel situation is such as to preclude any idle furnaces blowing in at this time. Prices of pig iron are fully maintained at the slightly advanced level. There are reports of small lots of bessemer and basic sold for third quarter at advances, but the general policy of consumers is not to buy ahead at this time. For prompt and near delivery we quote: Bessemer, $14.25; basic, $13; No. 2 foundry, $13.25; malleable, $13; forge, $12.75@13, f.o.b. Valley furnaces, 90c. higher delivered Pittsburg.

Ferromanganese — The market continues quiet, with the price quoted at $41 for prompt or forward, f.o.b. Baltimore.

Steel—Specifications on billet and sheet bar contracts have been excellent. Prices are somewhat stiffer. We quote, f.o.b. Pittsburg district mill: Bessemer billets, $29; sheet bars, $21; openhearth billets, $19.25@19.50; sheet bars, $19.50@20; f.o.b. Youngstown mill: Bessemer billets, $19.25@19.50; sheet bars, $19.50@20. Rods are about $25, Pittsburg.

Sheets—The American Sheet & Tin Plate Co. has withdrawn all prices on galvanized sheets under 2.90c. for 28 gage, and finds it is losing very little business from taking this stand. It is practically filled up for second quarter, and is not naming prices at all for third quarter. The independent mills are stiffening up somewhat. The sheet mills are operating at fully 85 per cent. of full capacity, some of the plants being operated at capacity. We quote: Black sheets, 28 gage, 1.80@1.85c.; galvanized, 2.80 @2.90c.; blue annealed, 1.35@1.40c., for 10 gage; painted corrugated roofing, $1.33@1.35; galvanized, $2.46@2.50 per square.

St. Louis

Mar. 25—The inquiry for iron improves with the advent of spring conditions. The demand for finished products seems to be much better and while this has not reacted on the pig-iron market to any extent, yet it will probably be felt later. While there is little chance of any immediate advance in iron yet prices are a little stiffer all around, as there has been enough buying to take care of the iron which producers were most anxious to get moving. Southern No. 2 foundry is being quoted at $10.25@10.50, Birmingham, or $14@14.25, St. Louis. Northern No. 2 is quoted at $14.25@14.75, St. Louis.

The coke market is very strong and supply scarcely up to the demand. Good 72-hour foundry coke is bringing $5.10@5.25, St. Louis.

Iron Ore Market

The movement of Lake iron has at last fairly started, on an open market, no agreement as to prices having been made, though the quotations seem to be fairly uniform. A considerable tonnage—reported as between 1,500,000 and 2,000,000 tons—has been placed. The prices are, f.o.b. Lake Erie ports, $3.75 per ton for Old Range bessemer and $3.50 for Mesabi bessemer, base 55% iron and under 0.45% phosphorus; $3.05 for Old Range nonbessemer and $2.85 for Mesabi bessemers, base 51.5% iron. The reduction from last season is 75c. per ton on bessemers and 65c. on nonbessemers.

The Interstate Commerce Commission has ordered a reduction in unloading charges at Lake Erie docks from 15c. to 8c. per ton. With this reduction it is understood that carrying charters from Duluth and Superior to Lake Erie ports will be made at about 50c. per ton.

Imports of iron ore into Great Britain, two months ended Feb. 29, were 1,248,298 long tons in 1911, and 1,181,141 in 1912; decrease, 67,157 tons. Imports of manganese ore were 58,092 tons in 1911, and 52,223 in 1912; decrease, 5869 tons.

British Iron and Steel Trade

Exports and imports of iron and steel, and of machinery, in Great Britain, two months ended Feb. 29, are valued by the Board of Trade returns as below:

	Exports	Imports	Excess
Iron and steel	£7,907,437	£2,021,532	Ex. £5,885,905
Machinery	5,013,298	1,024,516	Ex. 3,988,782
Cutlery and hardware	1,835,863	1,213,216	Ex. 622,647
New ships	711,714	.....	Ex. 711,714
Total	£15,468,312	£4,259,264	Ex. £11,209,048
Total, 1911	14,130,575	3,618,439	Ex. 10,512,136

Increase in exports £1,337,737; increase in imports, £640,825. The quantities of iron and steel were, in long tons:

	1911	1912	Changes
Exports	709,516	780,692	I. 71,176
Imports	265,686	325,736	I. 60,050

Tinplate exports to the United States decreased from 6718 tons in 1911 to 480 tons this year.

METAL MARKETS

New York, Mar. 27—A very considerable business is reported in the metal markets. Prices have been rather irregular, advancing in some lines, but inclining to weakness in others.

Gold, Silver and Platinum

UNITED STATES GOLD AND SILVER MOVEMENT

Metal	Exports	Imports	Excess
Gold			
Feb. 1912	$ 10,589,295	$ 2,937,274	Exp. $7,652,021
" 1911	424,733	5,805,844	Imp. 5,381,111
Year 1912	12,504,497	8,078,517	Exp. 4,425,980
" 1911	1,348,409	15,346,674	Imp. 13,998,265
Silver			
Feb. 1912	5,121,776	3,780,477	Exp. 1,341,329
" 1911	4,453,171	3,897,946	Exp. 555,225
Year 1912	11,149,681	8,138,486	Exp. 3,011,195
" 1911	10,104,247	7,449,372	Exp. 2,654,875

Exports from the port of New York, week ended March 23: Gold, $1,676,200, chiefly to Argentina; silver, $979,440, principally to London. Imports: Gold, $511,589, largely from Mexico; silver, $23,753, mainly from South America.

Gold—The price of gold on the open market in London remained at the usual level, 77s. 9d. per oz. for bars and 76s. 4d. per oz. for American coin. In New York gold was again taken for shipment to Argentina.

Iridium—There is nothing new in this market. The price is $64 per oz., New York.

Platinum—The market is still rather quiet and prices are unchanged. Dealers quote $45.50 per oz. for refined platinum, and $48 per oz. for hard metal.

Silver—The market continues steady; there is no special feature. London dealers have expressed the opinion that if the Chinese-foreign loans that have been pending for some time should be negotiated, the market for silver should show improvement.

SILVER AND STERLING EXCHANGE

Mar.	21	22	23	25	26	27
New York	58¼	58⅛	58¼	58¼	58¼	58⅛
London	26 1/16	26 1/16	26 1/16	26 1/16	26 1/16	26 1/16
Sterling Ex.	4.8725	4.8725	4.8720	4.8710	4.8710	4.8700

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Exports of silver from London to the East, Jan. 1 to Mar. 14, reported by Messrs. Pixley & Abell:

	1911	1912	Changes
India	£2,204,400	£1,533,800	D. £670,600
China	692,800	400,000	D. 292,800
Total	£2,897,200	£1,933,800	D. £963,400

India Council bills in London averaged 16.11d. per rupee for the week.

Gold in the United States, Mar. 1, is reported by the Treasury Department as follows: Held against gold certificates, $1,025,723,369; in Treasury balances, $173,367,028; in banks and circulation, $595,461,630; total, $1,794,552,027, a decrease of $8,730,294 during February.

Coined silver in the United States, Mar. 1, is reported by the Treasury Department as follows: Standard dollars, $565,239,367; subsidiary coin, $167,332,556; total, $732,571,923. Of the dollars, $477,919,000 are held in the Treasury against silver certificates.

Gold and silver movement in France, year ended Dec. 31:

	Imports	Exports	Excess
Gold	Fr. 296,425,000	Fr. 139,571,000 Imp.	Fr. 156,854,000
1910	231,538,000	173,631,000 Imp.	57,907,000
Silver	197,556,000	149,802,000 Imp.	47,754,000
1910	173,990,000	215,051,000 Exp.	41,061,00

Imports of nickel and copper coins in 1911 were 57,000 fr.; exports, 1,044,000 fr., face value.

Copper, Tin, Lead and Zinc

NEW YORK

Mar.	Copper: Lake, Cts. per lb.	Copper: Electrolytic, Cts. per lb.	Tin: Cts. per lb.	Lead: New York, Cts. per lb.	Lead: St. Louis, Cts. per lb.	Zinc: New York, Cts. per lb.	Zinc: St. Louis, Cts. per lb.
21	14⅞ @15	14.70 @14.80	42	4.10	4.10	6.45 @6.55	6.30 @6.40
22	14⅞ @15⅛	14.80 @14.90	42¼	4.20	4.17½ @4.20	6.45 @6.55	6.30 @6.40
23	14⅞ @15⅛	14.95 @15.00	42¼	4.20	4.17½ @4.20	6.45 @6.55	6.30 @6.40
25	15¼ @15⅜	15.10 @15.20	42⅝	4.20	4.17½ @4.20	6.45 @6.55	6.30 @6.40
26	15⅜ @15½	15.20 @15.35	42⅞	4.20	4.17½ @4.20	6.45 @6.55	6.30 @6.40
27	15⅜ @15½	15.32½ 15.35	42⅞	4.20	4.17½ @4.20	6.45 @6.55	6.30 @6.40

The quotations for copper, lead, spelter and tin are for wholesale contracts with consumers, without distinction as to deliveries; and are representative, as nearly as possible, of the bulk of the transactions, reduced to basis of New York, cash, except where St. Louis is specified as the basing point. The quotations for electrolytic copper are for cakes, ingots and wirebars. The price of electrolytic cathodes is usually 0.05 to 0.10c. and that for casting copper usually about 0.125 to 0.2c. below that of electrolytic. The quotations for lead represent wholesale transactions in the open market for good ordinary brands, both desilverized and non-desilverized; specially refined corroding lead commands a premium. The quotations on spelter are for ordinary Western brands; special brands command a premium.

LONDON

Mar.	Copper: Spot	Copper: 3 Mos	Copper: Best Sel'td	Tin: Spot	Tin: 3 Mos	Lead, Spanish	Zinc, Ordinaries
21	66 1/16	66 1/16	70¼	190¼	187¼	16¼	26
22	66¾	67 1/16	71	191¼	188¼	16 1/16	25⅞
23	.....	.....	.....	.....	.....	.....	.....
25	68 1/16	68⅜	72¼	194	191	16¼	25
26	68¼	69 1/16	72½	196	191¼	16 3/16	25
27	68¾	69⅝	73	196	191¼	16⅛	25¼

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c; £12 = 2.61c.; £23 = 5c.; £60 = 13.04c. ± £1 = ± 0.21¾c.

Copper—During the past week, a large business has been done, both for domestic consumption and export. Producers, being well sold up and having but small stocks, have advanced their prices from day to day, and during the same day, and their prices asked have been promptly paid by buyers. On Mar. 26 the price of 15½c., delivered, usual terms, was named and realized in the afternoon and on Mar. 27 the market rested firmly on that basis, but had become more dull. Previously a rather large volume of business had been transacted upon the advance. A curious feature has been the sluggishness in the demand for Lake copper for which some sellers report not even much inquiry and only a few sales. The market closes strong at 15.32½@15.35 for electrolytic in cakes, ingots and wirebars, and at 15.⅜@15½, nominally, for Lake. Casting copper is quoted nominally at 14¾@15c. as the average for the week.

There has been great activity in the London standard market. On Mar. 25, a sharp advance took place to £68 1s. 3d. for spot, and £68 17s. 6d. for three months, and the market closes at £68 15s. for spot, and £69 12s. 6d. for three months.

Copper sheets are 20@21c. base for large lots. Full extras are charged and higher prices for small quantities. Copper wire has again been advanced to 16⅜c. base, carload lots at mill.

Copper exports from New York for the week were 8090 long tons. Our special correspondent gives the exports from Baltimore at 2626 tons.

There have been labor difficulties at Butte and threats of a strike, owing to the discharge of some objectionable miners, but at the meetings of the men a conservative spirit has been manifested and our information is that a strike is improbable.

Brass Prices—Brass prices are announced by the American Brass Co., effective Mar. 22: Sheets, high brass, 16¼c. net per lb.; low brass, 17¾c. Wire, high brass, 16c.; low brass, 17¾c. Rods, high brass, 16c.; low brass, 18½c. Brass tubing, brazed, 21c.; open-seam, 19⅝c. Brass angles and channels, 20c. net per lb. Scrap allowances, 10¾c. net per lb. for high brass and 11¾c. for low brass.

Tin—The market was firm throughout the week. Business among dealers in this market was very active and of goodly proportions, and orders cabled to London from here helped along the advance over there. The close is strong at £196 for spot, and £191 5s. for three months, and about 42⅞c. for April tin in this market.

Tin output of the Federated Malay States two months ended Feb. 29 was 7734 long tons; an increase of 742 tons over last year.

Messrs. Robertson & Bense report the receipts of tin ore and concentrates at Hamburg, Germany, in February at 1384 tons, all from Bolivia.

Lead—The perplexity in the situation of lead referred to in our last report has increased this week. On March 22 the A. S. & R. Co. advanced its price to 4.20c., New York, but even at this advance outside sellers in this market have not seen fit to entertain business. In the meanwhile the price at St. Louis has advanced to a full parity with New York and sales of some fair tonnage have been made at that point by outside interests. There seems to be an effort on the part of the leading seller to keep lead out of the hands of speculative interests while it is being freely supplied to consumers. We quote 4.20c., New York, and 4.17½@4.20c., St. Louis.

The scarcity of lead in London continues, and the close is cabled at £16 2s. 6d. for Spanish, and 5s. higher for English lead.

Spelter—Buyers have held aloof and this market has been very dull. Spelter for April delivery has been offered at 6.40c. and some small business has been done at a little under that, while metal for May shipment is cheaper. The quotations of 6.30@6.40c., St. Louis, and 6.45@6.55c., New York, represent the range.

The London market declined on Monday to £25, and closes at £25 5s. for good ordinaries, and £25 10s. for specials.

Base price of zinc sheets on Mar. 20 was advanced 0.15c. and is now $8.65 per 100 lb., f.o.b. La Salle-Peru, Ill., less 8% discount.

Zinc dust is quoted at 7⅛c. per lb., New York.

Other Metals

Aluminum—Business is improving and prices are growing firmer, partly on account of a firmer foreign market, as well as larger sales. We quote 19½@20c. per lb. for No. 1 ingots, New York.

It is reported that the Aluminum Company of America has agreed to make certain modifications in its methods, in consideration of which the Department of Justice will take no action against it. It is reported also that the negotiations between the French and English producers have failed; but there is a possibility that they may be renewed.

Antimony—Business is better, and prices have advanced. Supplies of Chinese have been reduced, and the market is firm. Cookson's is now 8c. per lb. and Hallett's 7¾c.; while 6⅞@7c. is named for Chinese, Hungarian and other outside brands.

Quicksilver—The demand is fair, but quotations here are lower. The New York price is $43 per flask of 75 lb., while 62@64c. per lb. is quoted for retail lots. San Francisco is $42.50 for domestic orders and $40 for export. The London price is unchanged at £8 12s. 6d. per flask, with £8 7s. 6d. quoted from second hands.

Magnesium—The price of pure metal is $1.50 per lb. for 100-lb. lots, f.o.b. New York.

Spanish Metal Exports

Exports of metals and minerals from Spain, year ended Dec. 31, reported by *Revista Minera*, in metric tons:

Metals	1910	1911	Changes	
Pig and manuf. iron	36,855	41,439	I.	4,584
Copper	17,196	17,670	I.	484
Copper precipitate	14,094	13,601	D.	493
Lead	191,387	171,048	D.	20,339
Zinc	2,345	2,615	I.	270
Quicksilver	1,311	1,488	I.	177
Minerals				
Iron ore	8,284,059	7,282,279	D.	1,001,780
Manganese ore	6,322	33,266	I.	26,938
Copper ore	1,016,845	272,425	D.	744,420
Lead ore	3,519	3,473	D.	46
Zinc ore	124,593	121,768	D.	2,825
Pyrites	1,534,640	2,728,516	I.	1,193,876
Salt	496,138	524,110	I.	27,972

In 1910 pyritic ores were classed as copper ore when they carried 1% or over in copper; in 1911 such ores were not classed as copper ores unless they carried 2.5% or over in copper. This accounts for the large decrease in copper ore and the corresponding increase in pyrites.

Zinc and Lead Ore Markets

Platteville, Wis., Mar. 23—The base price paid this week for 60% zinc ore was $51@52. The base price paid for 80% lead ore was $50@51 per ton.

SHIPMENTS, WEEK ENDED MAR. 23

Camps	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Shullsburg	874,600	.....	.....
Mineral Point	872,000	.....	.....
Benton	641,200	.....	527,400
Galena	449,200	.....	.....
Platteville	421,740	.....	.....
Hazel Green	380,000	.....	.....
Cuba City	302,000	60,210	.....
Harker	167,050	.....	.....
Rewey	81,000	.....	.....
Montfort	70,000	.....	.....
Linden	64,120	.....	58,280
Total	4,322,910	60,210	585,680
Year to date	45,145,590	1,209,350	4,222,460

Shipped during week to separating plants, 1,940,280 lb. zinc ore.

Joplin, Mo., Mar. 23—Last week's promise of settled weather and heavy outputting held out only until the middle of this week. The latter part of the week there has been incessant rain, streams are out of their banks tonight and every mine in the district will be facing an increased water proposition on the resumption of work next week. This excess of rain, following a very wet ending of winter, not alone causes heavier pumping expense but the excessive moisture in the earth is endangering operations in a number of mines. Fears are entertained that heavy sliding will occur.

The high price of zinc sulphide ore was $55 per ton, the base price of 60% zinc $48@52. Zinc silicate sold on a base of $26@29 per ton of 40% zinc. Average

price, all grades zinc, $48.22 per ton. Lead sold as high as $57 per ton, with the general market $2 per ton higher than last week. Average, all grades of lead, $55.42 per ton.

SHIPMENTS, WEEK ENDED MAR. 23

	Blende	Calamine	Lead Ore	Value
Webb City-Carterville	3,596,870	. ....	1,125,650	$125,036
Joplin	1,332,960	.....	199,120	40,230
Alba-Neck	893,850	.....	126,680	27,553
Galena	374,450	.....	344,820	19,035
Duenweg	652,720	.....	32,780	17,887
Miami	278,900	.....	152,000	10,390
Granby	284,100	177,410	8,720	8,960
Oronogo	196,070	.....	57,540	8,450
Carl Junction	295,860	.....	.....	8,135
Cave Springs	193,090	.....	61,700	6,550
Jackson	205,840	.....	.....	5,145
Quapaw	115,300	.....	.....	2,650
Spurgeon	54,790	65,000	9,240	2,545
Carthage	82,970	.....	.....	2,074
Sarcoxie	.....	138,120	.....	1,933
Wentworth	63,670	.....	.....	1,590
Lawton	52,860	.....	.....	1,320
Springfield	44,200	.....	.....	1,150
Totals	8,818,400	370,530	2,118,250	$290,633
12 weeks	116,443,370	6,504,190	19,003,230	$3,304,735

Blende val., the week, $226,092; 12 weeks, $2,687,654
Calamine, the week, 5,558; 12 weeks, 91,327
Lead value, the week, 58,983; 12 weeks, 525,754

MONTHLY AVERAGE PRICES

Month	Zinc Ore				Lead Ore	
	Base Price		All Ores		All Ores	
	1911	1912	1911	1912	1911	1912
January	$41.85	$44.90	$40.55	$43.54	$55.68	$58.92
February	40.21	45.75	39.16	43.31	54.46	52.39
March	39.85	.....	38.45	.....	54.57	.....
April	38.88	.....	37.47	.....	56.37	.....
May	38.25	.....	36.79	.....	55.21	.....
June	40.50	.....	38.18	.....	56.49	.....
July	40.75	.....	38.36	.....	58.81	.....
August	42.50	.....	41.28	.....	60.74	.....
September	42.63	.....	41.29	.....	59.33	.....
October	42.38	.....	40.89	.....	54.72	.....
November	45.40	.....	43.25	.....	57.19	.....
December	44.13	.....	40.76	.....	62.03	.....
Year	$41.45	.....	$39.90	.....	$56.76	.....

NOTE—Under zinc ore the first two columns give base prices for 60 per cent. zinc ore; the second two the average for all ores sold. Lead ore prices are the average for all ores sold.

Other Ore Markets

Tungsten Ore—Ferberite, wolframite and huebnerite ores, $6.50@7 per unit per ton of 2000 lb. of ore containing 60 per cent. of tungsten trioxide. For scheelite ore, 50c.@$1.50 per unit less. These prices are delivered; a recent offer is noted of $5.50 per unit for huebnerite, 60% WO_3, f.o.b. railroad.

Vanadium Ore—A recent quotation for vanadinite, containing at least 10%, is 75c. per lb. for the V_2O_5 in the ore.

Molybdenum Ore—Recent prices offered for molybdenite, carrying 25% MoS_2, are $25 per ton; for wulfenite, at least 25% MoO_3, $100 per ton, f.o.b. railroad.

Chemicals

New York, Mar. 27—The general market has shown no special change during the week.

Copper Sulphate—Business continues on a good scale. Prices have advanced, chiefly on account of the rise in copper metal. Quotations are $5.10 per 100 lb. for carload lots and $5.35 per 100 lb. for smaller parcels.

Nitrate of Soda—Business is on the increase as spring approaches. Spot nitrate is a little higher, at 2.35c. per lb., while 2.30c. is still quoted for futures.

Arsenic—Spot supplies are insufficient for current demand, and there has been a sharp advance, to $3.50 per 100 lb. for early deliveries. For futures $3 per 100 lb. is quoted for white arsenic.

Mining Stocks

New York, Mar. 27—On Mar. 21, there was a halt in the upward move on the Exchange, due chiefly to profit taking. Amalgamated Copper continued to rise, however. Trading on the Curb was active. Copper shares sold freely at small advances. Lehigh Valley Coal Sales Co. advanced.

On Mar. 22, there were again some recessions, but advances marked the close. Amalgamated Copper, however, advanced, touching a high level at 78. Mining stocks on the Curb were generally active and strong.

Mar. 23 the Exchange continued strong and some fair advances were made. The Curb was active and generally strong, with a wide range of dealing in mining stocks. Coppers generally advanced, and there were large sales of Cobalt and Porcupine stocks.

Mar. 25 the Exchange continues active and further advances were made. Steel common closed above 70, while Amalgamated Copper went to 81½ at the close. The Curb Market for mining stocks was broad and active. Copper shares were in demand at advancing prices. Cobalts and Porcupines were in demand. Lehigh Valley Coal Sales Co. closed at 232, the highest price yet made.

Mar. 26 and 27 there was a halt in the upward movement, business being lighter and prices less firm. There was no marked recession, however, but rather an uncertainty. The Curb continued active with more dealing in mining stocks, copper shares being especially firm.

Boston, Mar. 26—The week has shown an active and broadening market for copper shares, with many advances in quotations. Today there was a halt and some recession, but this was manifestly due to profit taking, and the market closed firm and more active. Some brokerage houses report larger outside trading than for several years past.

Lake Copper made a new high record, with sales at $44. Calumet & Arizona advanced to $74, and North Butte to $33.25. Calumet & Hecla marked $475. Amalgamated has made a notable advance, in sympathy with New York quotations.

COPPER PRODUCTION REPORTS
Copper contents of blister copper, in pounds

Company	Dec.	Jan.	Feb.
Alaska shipments	4,995,008	3,701,010	.....
Anaconda	23,500,000	26,350,000	27,450,000
Arizona, Ltd.	3,100,000	3,200,000	3,020,000
Copper Queen	8,365,265	6,748,264	6,046,860
Calumet & Ariz.	4,486,000	4,544,000	4,452,004
Detroit	1,969,313	1,941,970	2,068,370
East Butte	1,498,000	1,520,000	.....
Mammoth	1,721,404	1,665,319	.....
Mason Valley	.....	600,000	.....
Nevada Con	4,679,674	6,309,228	.....
Old Dominion	2,610,000	2,044,000	2,039,000
Ray	2,660,000	2,475,945	2,140,000
Shannon	1,255,858	1,550,000	1,300,000
South Utah	267,814	189,678	283,838
United Verde*	2,000,000	2,000,000	2,250,000
Utah Copper Co	9,039,557	8,156,612	.....
Lake Superior*	17,500,000	17,500,000	19,000,000
Non-rep. mines*	8,500,000	8,400,000	.....
Total production	98,146,789	98,896,026	.....
Imports, bars, etc.	21,101,256	31,790,590	.....
Total blister	119,248,045	130,686,616	.....
Imp. in ore & matte	5,159,997	8,340,740	.....
Total	124,408,042	139,027,356	.....
Miami	2,557,580	2,235,647	2,475,996
Brit. Col. Cos.:			
British Col. Copper	.....	.....	.....
Granby	.....	1,607,558	.....
Mexican Cos.:			
Boleo	2,645,640	2,315,040	2,204,720
Cananea	3,706,000	3,552,000	.....
Moctezuma	2,864,464	2,732,867	2,687,712
Other Foreign:			
Cape Cop., S. Africa	701,120	784,000	786,440
Kyshtim, Russia	1,555,000	.....	.....
Spassky, Russia	721,280	795,200	.....
Famatina, Argen.	217,280	172,480	.....
Tilt Cove, Newf'd.	.....	153,257	109,059
Exports from:			
Chile	5,824,000	8,064,000	6,720,000
Australia	11,200,000	7,056,000	7,164,000
Arrivals in Europe†	16,331 840	13,144,320	10,868,680

Figures are reports received from companies, unless otherwise stated. Boleo copper does not come to American refiners. Miami copper goes to Cananea for treatment, and reappears in imports of blister.
*Estimated. †Does not include the United States, Australia or Chile.

STATISTICS OF COPPER.

Month	United States Product'n	Deliveries, Domestic	Deliveries for Export
II, 1911	109,828,297	50,518,998	45,111,019
III	130,532,080	66,080,789	59,081,127
IV	118,085,223	52,407,650	62,129,599
V	126,962,544	64,543,963	61,978,557
VI	124,554,312	61,655,561	71,460,519
VII	112,167,934	56,982,582	74,880,658
VIII	125,493,667	59,935,364	69,855,660
IX	115,588,950	57,311,584	50,824,011
X	118,255,442	64,068,307	60,084,349
XI	111,876,601	68,039,776	67,049,279
XII	122,896,697	65,988,474	79,238,716
Year, 1911	1,431,938,338	709,611,605	754,902,233
I, 1912	119,337,753	62,343,901	80,167,904
II	116,035,809	56,228,368	63,148,096

	Visible Stocks		
	United States	Europe	Total
III, 1911	156,637,770	233,385,600	390,023,006
IV	162,007,934	223,014,400	385,022,434
V	165,555,908	212,284,800	377,840,708
VI	165,995,932	202,540,800	368,536,732
VII	157,434,164	195,932,800	353,366,964
VIII	137,738,858	191,891,840	329,630,698
IX	133,441,501	191,228,800	324,670,301
X	140,894,856	191,945,600	332,840,456
XI	134,997,642	176,825,600	311,823,242
XII	111,785,188	164,281,600	276,066,788
I, 1912	89,454,695	158,323,200	247,777,895
II	66,280,643	154,851,200	221,131,843
III	62,939,988	141,142,400	204,082,388

Figures are in pounds of fine copper. U. S. production includes all copper refined in this country, both from domestic and imported material. Visible stocks are those reported on the first day of each month, as brought over from the preceding month.

The Curb has also been broad and active, with large sales and many advances. Rhode Island Coal was dealt in around 30c. per share.

Arrangements are being made to list Ahmeek shares on the Stock Exchange.

Assessments

Company	Delinq	Sale	Amt
Alameda, Idaho	Apr. 1	.....	$0.005
Algomah, Mich	Jan. 22	.....	1.00
Alpha Con., Nev	Feb. 21	Mar. 13	0.05
Belcher, Nev	Apr. 8	Apr. 30	0.10
Best & Belcher, Nev	Mar. 19	Apr. 8	0.05
Black Jack, Utah,	Feb. 6	.....	0.01
Boston Ely, Nev	Jan. 18	.....	0.50
Challenge, Nev	Mar. 5	Mar. 26	0.05
Crown Point, Nev	Mar. 28	Apr. 19	0.05
Crown Point, Utah	Feb. 15	Mar. 11	0.005
Ely Con., Nev	.....	.....	0.05
Exchequer, Nev	Feb. 14	Mar. 6	0.05
Hancock, Mich	Mar. 28	.....	1.00
Kentuck, Nev	Feb. 29	Mar. 19	0.05
King David, Utah	Feb. 13	Mar. 6	0.005
Lehi Tintic, Utah	Feb. 29	.....	0.01½
Leonora, Utah	Apr. 15	Apr. 30	0.0125
Lower Mammoth, Utah	Mar. 16	.....	0.01
New York Bonanza, Utah	Mar. 14	Apr. 4	0.02
Ojibway, Mich	Jan. 10	.....	1.005
Overman, Nev	Apr. 9	Apr. 30	0.05
Raven, Mont	Feb. 1	.....	0.10
Savage, Nev	Feb. 14	Mar. 7	0.10
Sierra Nevada, Nev	Apr. 3	Apr. 24	0.10
Southwestern Miami, Ariz.	Jan. 15	.....	1.00
Tintic Central, Utah	Mar. 9	Mar. 27	0.005
Union Con., Nev	Feb. 10	Mar. 12	0.15
Wabash, Utah	Mar. 19	Apr. 10	0.10

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1910	1911	1912	1910	1911	1912
January	52.375	53.795	56.260	24.154	24.865	25.887
February	51.534	52.222	59.043	23.794	24.081	27.190
March	51.454	52.745	.....	23.690	24.324	.....
April	53.221	53.325	.....	24.483	24.595	.....
May	53.870	53.308	.....	24.797	24.583	.....
June	53.462	53.043	.....	24.651	24.486	.....
July	54.150	52.630	.....	25.034	24.286	.....
August	52.912	52.171	.....	24.428	24.082	.....
September	53.295	52.440	.....	24.567	24.209	.....
October	55.490	53.340	.....	25.596	24.594	.....
November	55.635	55.719	.....	25.680	25.649	.....
December	54.428	54.905	.....	25.160	25.349	.....
Year	53.486	53.304	.....	24.670	24.592	.....

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

	New York				London, Standard	
	Electrolytic		Lake			
	1911	1912	1911	1912	1911	1912
January	12.295	14.094	12.680	14.337	55.600	62.760
February	12.256	14.084	12.611	14.329	54.974	62.893
March	12.139	.....	12.447	.....	54.704	.....
April	12.019	.....	12.275	.....	54.034	.....
May	11.989	.....	12.214	.....	54.313	.....
June	12.385	.....	12.611	.....	56.365	.....
July	12.463	.....	12.720	.....	56.673	.....
August	12.405	.....	12.634	.....	56.266	.....
September	12.201	.....	12.508	.....	55.253	.....
October	12.189	.....	12.370	.....	55.170	.....
November	12.616	.....	12.769	.....	57.253	.....
December	13.552	.....	13.768	.....	62.068	.....
Year	12.376	.....	12.634	.....	55.973	.....

New York, cents per pound, London, pounds sterling per long ton of standard copper.

TIN AT NEW YORK

Month	1911	1912	Month	1911	1912
January	41.255	42.529	July	42.400	.....
February	41.614	42.962	August	43.319	.....
March	40.157	.....	September	39.755	.....
April	42.185	.....	October	41.185	.....
May	43.115	.....	November	43.125	.....
June	44.606	.....	December	44.655	.....
			Av. Year	42.281	.....

Prices are in cents per pound.

LEAD

Month	New York		St. Louis		London	
	1911	1912	1911	1912	1911	1912
January	4.483	4.435	4.334	4.327	13.009	15.619
February	4.440	4.026	4.266	3.946	13.043	15.738
March	4.394	.....	4.238	.....	13.122	.....
April	4.412	.....	4.262	.....	12.889	.....
May	4.373	.....	4.223	.....	12.984	.....
June	4.435	.....	4.292	.....	13.260	.....
July	4.499	.....	4.397	.....	13.530	.....
August	4.500	.....	4.406	.....	14.260	.....
September	4.485	.....	4.356	.....	14.744	.....
October	4.265	.....	4.139	.....	15.332	.....
November	4.298	.....	4.181	.....	15.821	.....
December	4.450	.....	4.332	.....	15.648	.....
Year	4.420	.....	4.286	.....	13.970	.....

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

SPELTER

Month	New York		St. Louis		London	
	1911	1912	1911	1912	1911	1912
January	5.452	6.442	5.302	6.292	23.887	26.642
February	5.518	6.499	5.368	6.349	23.276	26.661
March	5.563	.....	5.413	.....	23.016	.....
April	5.399	.....	5.249	.....	23.743	.....
May	5.348	.....	5.198	.....	24.375	.....
June	5.520	.....	5.370	.....	24.612	.....
July	5.695	.....	5.545	.....	25.006	.....
August	5.953	.....	5.803	.....	26.801	.....
September	5.869	.....	5.719	.....	27.750	.....
October	6.102	.....	5.951	.....	27.256	.....
November	6.380	.....	6.223	.....	26.795	.....
December	6.301	.....	6.151	.....	26.849	.....
Year	5.758	.....	5.608	.....	25.281	.....

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

PIG IRON AT PITTSBURG

	Bessemer		Basic		No. 2 Foundry	
	1911	1912	1911	1912	1911	1912
January	$15.90	$15.12	$14.40	$13.32	$14.75	$14.00
February	15.90	15.03	14.50	13.28	14.81	14.01
March	15.90	.....	14.65	.....	14.96	.....
April	15.90	.....	14.65	.....	15.00	.....
May	15.90	.....	14.30	.....	14.72	.....
June	15.90	.....	14.06	.....	14.56	.....
July	15.90	.....	14.03	.....	14.53	.....
August	15.90	.....	14.00	.....	14.47	.....
September	15.90	.....	13.57	.....	14.40	.....
October	15.43	.....	13.44	.....	14.34	.....
November	14.92	.....	13.30	.....	14.25	.....
December	15.15	.....	13.10	.....	13.90	.....
Year	$15.72	.....	$13.94	.....	$14.49	.....

STOCK QUOTATIONS

COLO. SPRINGS Mar. 26

Name of Comp.	Bid.
Acacia	.05½
Cripple Cr'k Con.	.01½
C. K. & N.	.16
Doctor Jack Pot	.06⅜
Elkton Con	.61
El Paso	.71½
Findlay	.04½
Gold Dollar	.14½
Gold Sovereign	.02½
Isabella	.12½
Jack Pot	.05
Jennie Sample	.04⅞
Lexington	.01
Moon Anchor	.01
Old Gold	.03
Mary McKinney	.53½
Pharmacist	.02
Portland	.91⅞
Vindicator	.71½
Work	.00½

SALT LAKE Mar. 26

Name of Comp.	Bid.
Beck Tunnel	.14
Black Jack	.15
Carisa	‡.15
Cedar Talisman	.01⅜
Colorado Mining	.29
Columbus Con	.20
Daly-Judge	5.50
Grand Central	.65
Iron Blossom	1.30
Little Bell	.36
Lower Mammoth	.04½
Mason Valley	12.75
May Day	.15
Nevada Hills	2.42½
New York	.05⅞
Prince Con	1.17½
Silver King Coal'n	1.35
Sioux Con	.04½
Uncle Sam	.25
Yankee	‡.15

TORONTO Mar. 26

Name of Comp.	Bid	Name of Comp.	Bid
Coniagas	‡7.05	Hollinger	11.50
Hudson Bay	‡70.00	Imperial	.07
Temiskaming	.47½	Pearl Lake	.20
Wettlaufer-Lor	.65	Porcu. Gold	.44
Apex	.06	Porcu. Tisdale	.03
Central	4.62½	Preston E. D.	.10
Crown Chartered	.28	West Dome	.40
Dobie	‡.65	Standard	.15
Dome Exten	.56	Rea	.70
Foley O'Brien	.30	Swastika	.23

SAN FRANCISCO Mar. 26

Name of Comp.	Clg.	Name of Comp.	Bid
COMSTOCK STOCKS		MISC. NEV. & CAL.	
Alta	.08	Belmont	10.00
Belcher	.84	Jim Butler	.62
Best & Belcher	.19	MacNamara	.24
Caledonia	4.40	Midway	.36
Challenge Con	.35	Mont.-Tonopah	2.65
Chollar	.16	North Star	.30
Confidence	1.05	West End Con	1.87½
Con. Virginia	.75	Atlanta	.29
Crown Point	.94	Booth	.10
Gould & Curry	.07	C.O.D. Con	.10
Hale & Norcross	.45	Comb. Frac	.22
Mexican	3.50	Jumbo Extension	.44
Occidental	.65	Pitts.-Silver Peak	1.35
Ophir	1.45	Silver Pick	.10
Overman	2.30	St. Ives	.40
Potosi	.12	Tramp Con	‡.01
Savage	.31	Argonaut	2.25
Sierra Nevada	.28	Bunker Hill	‡5.50
Union Con	1.00	Cent. Eureka	.22
Yellow Jacket	1.27½	So. Eureka	‡5.00

N. Y. EXCH. Mar. 26

Name of Comp.	Clg.
Amalgamated	80⅛
Am. Agri. Chem.	62¼
Am.Sm.&Ref.,com	87¼
Am. Sm.& Ref., pf.	107
Am. Sm. Sec., pf. B	87
Anaconda	41⅛
Batopilas Min	1⅛
BethlehemSteelpf	62⅝
Chino	27⅛
Federal M.& S., pf.	45⅛
Goldfield Con	4⅞
Great Nor.,ore ctf.	41¼
Homestake	91
Miami Copper	25⅞
Nat'nalLead,com.	58
National Lead, pf.	106⅞
Nev. Consol	20⅛
Pittsburg Coal, pf.	81⅞
Ray Con	18½
RepublicI&S,com	22½
Republic I & S, pf.	74
SlossSheffi'd,com.	47½
Sloss Sheffield, pf.	105
Tennessee Copper	40
Utah Copper	61¾
U. S. Steel, com.	68⅞
U. S. Steel, pf.	113⅛
Va. Car. Chem	54¾

N. Y. CURB Mar. 26

Name of Comp.	Clg.
Barnes King	‡.12
Beaver Con	.50
Braden Copper	5⅛
B. C. Copper	5⅛
Buffalo Mines	1⅛
Butte & Vipond	‡.53
Caledonia	.68
Con. Ariz. Sm.	9/16
Davis-Daly	1 1/16
Diam'field-Daisy	12
Ely Con	5/16
Florence	‡.64
Giroux	5
Gold Hill Con	1/16
Greene Cananea	9⅛
Greenwater	.08
Guggen. Exp	212
Inspiration Con	19¾
Internat. S. & R.	‡128
LaGrange Placer	2⅞
Kerr Lake	3
La Rose	4
McKinley-Dar-Sa.	1 11/16
Min. Co. of A. new	3⅛
Nev. Utah M. & S.	1/16
Nipissing Mines	8⅛
Ohio Copper	1⅛
Pacific Sm. & M.	1/16
Porcupine T'nsite	‡.03 1/32
Precious Metals	‡1 3/16
Ray Central	2⅛
Red Warrior	‡1 3/32
South Utah M. & S.	1
Standard Oil (Old)	842
Stand'd Oil of N.J.	357
Stand'd Oil Subs.	485
Stewart	1 1/16
Tonopah	8
Tonopah Ex	1⅞
Tri-Bullion	¾
Tularosa	¾
United Cop., pfd.	15
Yukon Gold	3 3/16

LONDON Mar. 27

Name of Com.	Clg.
Camp Bird	£1 10s 9d
Dolores	1 10 0
El Oro	0 17 9
Esperanza	1 15 3
Mexico Mines	7 2 6
Oroville	0 4 6
Stratton'sInd.	0 3 1½
Tomboy	1 1 3

BOSTON EXCH. Mar. 26

Name of Comp.	Clg.
Adventure	6½
Algomah	5¾
Allouez	45
Am. Zinc	27¼
Ariz. Com., ctfs.	4⅝
Bonanza	.40
Boston & Corbin	8
Butte & Balak	3⅞
Calumet & Ariz	73¾
Calumet & Hecla	473
Centennial	21⅜
Con. Mercur	.03
Copper Range	61½
Daly West	6¾
East Butte	13⅞
Franklin	14¾
Granby	39½
Hancock	31¾
Hedley Gold	18
Helvetia	1¾
Indiana	16⅞
Island Cr'k, com.	43
Island Cr'k, pfd.	‡87
Isle Royale	27¾
Keweenaw	1⅜
Lake	44
La Salle	‡5
Mass	8
Michigan	3
Mohawk	63
New Arcadian	4¾
New Idria Quick.	‡8
North Butte	33
North Lake	7½
Ojibway	6
Old Dominion	51
Osceola	117
Quincy	84
Shannon	14¾
Shattuck-Ariz.	19¾
Superior	29
Superior & Bost.	3¾
Tamarack	29
Trinity	6¼
Tuolumne	4 1/16
Union Mines	2
U. S. Smelting	39¾
U. S. Smelt'g, pf.	48⅞
Utah Apex	3
Utah Con	19
Victoria	4¾
Winona	6¾
Wolverine	115
Wyandot	2½

BOSTON CURB Mar. 26

Name of Comp.	Last
Ahmeek	278
Bingham Mines	3½
Boston Ely	1⅞
Boswyocolo	.08
Butte Central	6½
Cactus	.18
Calaveras	2
Chief Cons	1 15/16
Corbin	2⅞
Cortez	1
Crown Reserve	3
First Nat. Cop.	2
Majestic	.78
Mazatan	‡½
Moneta Porc.	.15
Nevada-Douglas	4
New Baltic	3½
Oneco	2⅝
Raven Copper	.45
Rhode Island Coal	20
San Antonio	‡3
S. W. Miami	7
South Lake	7
Tretheway	.65
United Verde Ext.	.55
Vulture	‡5

‡Last quotation.